California High-Speed Train Project

TECHNICAL MEMORANDUM

Los Angeles to Anaheim
Concept Level Operational Feasibility Study
TM 4.1

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Prepared by PB

for the California High-Speed Rail Authority

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1.0 EXECUTIVE SUMMARY

A concept level analysis was undertaken to estimate the number of High Speed Trains (HST) that could be operated on the LOSSAN Corridor between Los Angeles Union Station (LAUS) and the Anaheim Regional Transportation and Intermodal Center (Anaheim). This study examined the feasibility of four different track configuration and operational scenarios with future service forecasts depicting freight and passenger train volumes, including the HST, approaching the year 2030. These scenarios focused on the mainline segment between Redondo Junction, Fullerton and Anaheim and are described as follows:

1. A total of four tracks, with two interconnected tracks exclusively for freight and two interconnected tracks exclusively for passenger trains, between Redondo Junction and Fullerton; no physical connection between the two freight tracks and two passenger tracks. Two tracks between Fullerton and Anaheim.
2. A total of five tracks, with three interconnected tracks exclusively for freight and two interconnected tracks exclusively for passenger trains, between Redondo Junction and Fullerton; no physical connection between the three freight tracks and two passenger tracks. Two tracks between Fullerton and Anaheim.
3. A total of five tracks, with three interconnected tracks for freight and conventional passenger trains and two interconnected tracks exclusively for passenger trains ("shared use" for Metrolink commuter and HST), between Redondo Junction and Fullerton. Two tracks between Fullerton and Anaheim.
4. A total of six tracks between Redondo Junction and Fullerton with four interconnected tracks for freight and passenger trains and two interconnected tracks potentially exclusive for the High Speed Train; these dedicated tracks for the High Speed train continue on from Fullerton to Anaheim in addition to two tracks for the operation of freight and conventional passenger trains.
5. A No-Build scenario with a total of Three Mainline Tracks from Redondo Junction to Fullerton (Step 1) with three interconnected tracks for the operation of freight trains, Amtrak and Metrolink. Step 2 is a total of Four Mainline Tracks from Fullerton to Anaheim, with four interconnected tracks for the operation of freight trains, Amtrak and Metrolink,

The future daily service (total trains - both directions) assumed in the analysis included thirty two Amtrak trains, one hundred one Metrolink trains (from the Metrolink Strategic Assessment published in January 2007 plus the extension of the new Orange County thirty minute service from Fullerton to LAUS) and one hundred thirty three freight trains, representing fifty percent growth over a twenty year time frame (for freight service). HST service was derived from recent ridership demand forecasts and examined in the analysis from one to four trains per hour (each direction) when operating on the same tracks as conventional passenger trains and six or more trains per hour (each direction) when operating on dedicated (HST) tracks.

Each of the track configuration concepts was simulated using the Berkeley Simulation Rail Traffic Controller (RTC) Model to estimate the feasibility of the various track configuration concepts to support the assumed train volumes. In summary, the results of the study and associated analysis indicated that:

- Two exclusive freight tracks do not provide ample capacity for the forecasted freight train volume; however, three exclusive freight tracks proved feasible to support assumed freight train growth through the year 2027.
- Two exclusive passenger tracks provide ample capacity for the forecasted conventional passenger trains (Amtrak and Metrolink) plus a maximum (average) of only one HST per hour in each direction.

- Some grade separation of freight and passenger tracks is likely to be needed; daily freight operations require certain “cross plant” train movements, from north to south, across all of the tracks on the Corridor.
- The ability to make the required “cross plant” freight train movements (up to forty per day) can be provided by grade separating two tracks at key locations, possibly by building them on an aerial structure, for the HST and certain Metrolink trains or exclusively for the HST.
- In examining the concept of operating freight and conventional passenger trains on the same tracks, three interconnected tracks within the existing footprint of the Corridor between Redondo Junction and Fullerton can feasibly support the forecasted volume of freight trains plus Metrolink 91-Line trains and Amtrak intercity service.
- The evaluation of a concept that would dedicate two mainline tracks for the HST and certain Metrolink trains between Redondo Junction and Fullerton revealed that this configuration could feasibly support the Metrolink Orange County services (Oceanside, Laguna Niguel, LAUS) forecast for the year 2030 and up to 4 HST per hour in each direction.
- The two track mainline section between Fullerton and Anaheim would likely be subject to “time separation” for freight trains if these tracks are used exclusively for passenger trains (including the HST) during normal passenger service hours of operation.
- The analysis determined that two main tracks dedicated to the HST from LAUS to Anaheim can support 6 HST per Hour in each direction. Also this configuration has the potential of supporting up to 20 HST per hour in each direction or a combination of HST and Metrolink trains, depending on the design of the signal system and configuration of the end terminals at LAUS and Anaheim which may be the subject of further study.
- Capacity utilization is maximized when the tracks for freight and conventional passenger trains are interconnected.
- Operational performance and service potential is optimized when HST and Metrolink trains operating on the same tracks possess similar performance characteristics, e.g. acceleration, deceleration and maximum speeds.
- Optimal maximum speed for the HST is 125 mph between LAUS and Anaheim. A maximum speed of 150 mph was examined and determined to be unachievable and the difference in overall trip time between 150 mph and 125 mph is only five seconds. The difference between 125 mph and 110 mph is twenty-six seconds.

Further details associated with each concept, the analysis and results are presented in this report.

2.0 INTRODUCTION

The California High Speed Train (HST) System is being proposed as a very high speed steel wheel on steel rail train operation that will provide service throughout the State of California with end terminals in Sacramento, San Francisco, Fresno, Bakersfield, Los Angeles, Anaheim and San Diego. As part of the process associated with evaluating service and alignment alternatives being developed for potential California HST service between Los Angeles and Orange County, a series of operational analyses were undertaken to estimate the number of HST that could be accommodated considering different mainline track configuration concepts and future forecasted freight, Amtrak, and Metrolink services. Therefore, the purpose of this study is a concept level operational analysis of that segment of the proposed High Speed Rail Network between Los Angeles Union Station (LAUS) and the Anaheim Regional Transportation and Intermodal Center (Anaheim), which is a distance of approximately 31 miles. The specific focus is to review mainline capacity between Redondo Junction and Anaheim as well as the approach to LAUS from Redondo Junction. Redondo Junction is an interlocking that serves as the entrance to the Alameda Corridor, which is the primary freight corridor to and from the Ports of Los Angeles and Long Beach for both the BNSF Railway and the Union Pacific Railroad. Metrolink and Amtrak operations are grade separated from the freight railroads at this location. This segment of the Corridor is part of the existing west (LAUS) to east (Anaheim) rail Corridor that serves freight and passenger customers along the 128 mile corridor between Los Angeles and San Diego referred to as the LOSSAN Corridor.

2.1 BACKGROUND

Redondo Junction to Fullerton Junction

The portion of the LOSSAN Corridor between Redondo Junction (in Los Angeles County) and Fullerton Junction (in Orange County) is owned and operated by the BNSF Railway. The tracks are shared between BNSF freight trains, Amtrak intercity trains and Metrolink commuter rail services. This segment of the LOSSAN Corridor is currently configured, depending on the location, with a combination of either two or three main tracks within the railroad right of way (refer to Appendix A-Figure 1); completion of three contiguous main tracks is planned over the next five to ten years. Phase 1 of this project between Commerce and Pico Rivera and between La Mirada and Basta will be complete prior to 2010, however funding availability for the completion of Phase 2 of this project is not known at this time. Currently, seventy to eighty freight trains utilize the track capacity between these two points daily and during some periods it is not uncommon to observe the operation of up to a total of ninety trains in a single day. In addition, typical weekday passenger service includes twenty two Amtrak and twenty eight Metrolink trains (total of fifty passenger trains). The freight and passenger trains share this segment of the LOSSAN Corridor based on track availability during most of the day, however the passenger trains receive priority consideration for movement during their peak service periods in the morning and afternoon.

In addition to the passenger trains and long-haul “through” freight trains, “local” freight trains operate on certain sections of the main tracks and traverse across these tracks, requiring up to forty “cross plant” train movements on a daily basis. These “cross plant” operations are necessary in order to deliver freight cars between railroad customers and rail yards located on both the north and south sides of the Corridor. These main tracks are also potentially subject to delay-causing congestion when high levels of freight train volume within a short time frame requires arriving trains to be “parked” on a main track, awaiting an available yard track in Hobart Yard.

It is worthy to note the unique configuration of the Metrolink Commerce Station and the influence it has on current daily operations. Located directly across the mainline tracks from the local BNSF locomotive servicing facility, this station is a single side platform positioned on the south side of the Corridor mainline tracks. This south side location of the station platform effectively reduces a discrete portion of the Corridor in this area to a single track operating dynamic when Metrolink trains destined for LAUS make a station stop to receive and/or discharge passengers. This condition is caused by the necessity of these westbound trains to “cross over” from the mainline track on the north side of the Corridor to the south side track that is adjacent to the Commerce station platform. At times, these train movements also create potential dispatching conflicts with BNSF freight trains.

Fullerton Junction to Anaheim

The portion of the LOSSAN Corridor between Fullerton and Anaheim is operated by Metrolink and owned by the Orange County Transportation Authority (OCTA). Two mainline tracks are shared on a typical weekday between nineteen Metrolink commuter trains, twenty two Amtrak intercity trains, and a small number of freight trains; two BNSF locals that operate between La Mirada and La Palma and one UPRR local that operates between Control Point (CP) College and Costa Mesa. It is also important to note that each day one UPRR train traverses the diamonds crossing the LOSSAN Corridor at CP College. The majority of these freight trains currently operate during daytime hours. Consequently, if the double track segment of the Corridor between Fullerton and Anaheim were to be assigned exclusively to passenger trains within the hours of operation associated with a typical passenger service day, the freight trains would have to be restricted with time separation to a night time only operation.

"Cross Plant" Freight Train Movements

It is critically important to be aware of, and address mitigations to, the (north – south) "traversing" local trains and yard movement occupancies of the mainline tracks in the study area. As illustrated in Appendix A-Figure 2, the following "cross plant" track occupancies occur on a typical day:

- Six train movements between Hobart Yard and the BNSF 1st Street Yard (along the River Subdivision).
- Fifteen train movements between Hobart Yard and Commerce Yard.
- Six train movements between Pico Rivera and La Mirada
- Six train movements between La Mirada and Fullerton Junction
- Four train movements between Fullerton Junction and Orange

Of the four different mainline track configuration concepts examined in the analysis described later in this report, two of the scenarios assume complete separation of freight and passenger tracks, and two of the scenarios assume physically separating a double track for the HST with either three or four interconnected tracks for all other trains (total of either five or six tracks).

3.0 OBJECTIVE

The objective of this operations analysis was to conduct a concept-level feasibility study to estimate the number of HST that could be operated on mainline tracks between LAUS and Anaheim considering:

- ○ The level and frequency of service forecast for freight, Amtrak and Metrolink approaching the year 2030;
- ○ Specific conceptual main line track configuration alternatives within the study area and;
- ○ Operating assumptions pertaining to different scenarios including:
  - Exclusive use of certain tracks for only freight trains with exclusive use of other tracks for only passenger trains (Amtrak, Metrolink, and HST).
  - Operations on certain tracks for a combination of freight trains, Amtrak and Metrolink trains with other tracks used exclusively for the "shared" operation of Metrolink and the HST.
  - Operations on certain tracks for a combination of freight trains, Amtrak and Metrolink trains with exclusive use of other tracks for the HST.

4.0 SIMULATION MODEL

The Berkeley Simulation Software Rail Traffic Controller (RTC) simulation software (the Model) was used to simulate operations for each of the scenarios identified in this study along the LOSSAN Corridor. The Model was selected because it accurately simulates passenger and freight operations using the performance characteristics of specific train-set technologies and replicates the horizontal and vertical geometric attributes of the track infrastructure. It provides the range of information and analytical and reporting capabilities required for this analysis and was designed as a flexible tool that can be modified, refined and upgraded to examine a variety of operational and infrastructure alternatives. This dynamic train simulation instrument is also the Model that was used as the primary tool for operations/capacity analysis and infrastructure validation for the California High Speed Rail Tier I Programmatic Document and the recent

development of the OCTA/ Metrolink service expansion program along the LOSSAN Corridor segment between Fullerton and Laguna Niguel, in southern Orange County.

5.0 ASSUMPTIONS

There are three principal categories of assumptions that were used as inputs to the simulation model and the analysis:

- Train Characteristics
- Operations and Service
- Infrastructure / Mainline Track Configuration

5.1 TRAIN CHARACTERISTICS

The performance characteristics for the different types of train-set technologies and associated rail vehicle consists that are representative of those that will potentially be operating on the LOSSAN Corridor in the year in which the HST is proposed to be providing service between LAUS and Anaheim were used in the Model. The train characteristics that are universally applicable to all of the simulation Model "Cases" include:

- For the HST: characteristics based upon the specifications for the Siemens ICE-3 train-set.
- For Freight Trains: characteristics based upon the specifications for a range of motive power, typical and specific by train, including the GE Dash 9-44CW and GE GP-38. Consists were based upon current train patterns.
- For Conventional Diesel Passenger Trains (Amtrak and Metrolink): propulsion characteristics based upon the specifications for F59PHI locomotive. Amtrak Pacific Surfliner consists were assumed to operate with 6 coaches. Metrolink 91-Line trains were assumed to operate with 6 coaches. Metrolink "30-Minute" Orange County Service trains were assumed to operate with 4 coaches. Amtrak long distance inter-city trains were assumed to operate with P-42 locomotive technology and 10 coaches.
- For Conventional Electric Passenger Trains (in cases where electric propulsion was assumed/tested for some Metrolink service): characteristics based upon the specification for the AEM-7 locomotive. The train consist was assumed to operate with 5 coaches.

5.2 COMMON OPERATING ASSUMPTIONS

The common operating assumptions universally applied in the Model to all simulation Cases are as follows:

- Service day for passenger train operations between 3:00 AM and 12:00 AM
- Public service hours of operation between the hours of 4:00 AM and 11:30 PM
- OCTA / Metrolink "30 Minute" Service Program extended from Fullerton to LAUS
- Amtrak NOT assumed as part of the OCTA / Metrolink "30 Minute" Service Program
- Orange County Metrolink commuter trains originate or terminate at LAUS, Laguna Niguel or Oceanside. Trains currently originating or terminating at Irvine or San Juan Capistrano are assumed to be moved to Laguna Niguel. Trains originating or terminating at Fullerton in the future-near term OCTA / Metrolink "30 Minute" service expansion program are assumed to be moved to LAUS

- Future planned levels of service for the 91-Line, Orange County Line, and IEOC Line as described in the Southern California Regional Rail Authority (Metrolink) Strategic Assessment published in early 2007
- Does NOT include a detailed operational study of existing terminal operations at LAUS for Amtrak and Metrolink trains
- Does NOT include a detailed operational study of the proposed terminal operations at LAUS for the High Speed Train (a study examining the capacity requirements and "footprint" for the HST LAUS Terminal Station will be documented in a separate report.)
- Additional BNSF freight trains based upon an assumption of two percent per year annual growth for twenty years; from current conditions (2007) to the year 2027

5.3 COMMON SERVICE LEVEL ASSUMPTIONS

The common service level assumptions universally applied in the Model to all simulation Cases are as follows:

Freight Trains

As previously stated, BNSF currently operates up to ninety freight trains per day between Redondo and Fullerton Junctions, and for purposes of this study, growth was assumed to be at a rate of two percent per year over a twenty year period between 2007 and 2027. The results of applying this growth factor yielded a total of 133 freight train movements per day on this segment of the Corridor; this is the volume of trains that was consistently assumed in the simulation Cases. The freight train movements, by train type and time of day, were patterned on the basis of existing operations.

Conventional Passenger Trains

Conventional passenger service currently operating within the study area (of the LOSSAN Corridor) includes Metrolink commuter and Amtrak intercity trains. The future service levels assumed in each of the simulation Model cases are summarized in Figure 5.3.1 and compared to existing service plans.

Figure 5.3.1: Conventional Passenger Trains per Weekday

Service	Current	Future/Modeled
Amtrak Pacific Surfliner	22	32
Amtrak Long Distance	2	2
91 Line: LA-Riverside	9	24
91 Line: LA-Perris	-	
LAUS-Oceanside	10	10
LAUS-Laguna Niguel	9	67
Fullerton-Laguna Niguel	-	
*IEOC	16	26

**Noted but not included in the simulation Model study area which ends at Anaheim*

The Metrolink future service levels are based on the Metrolink Strategic Assessment published in January 2007. These future service levels include the Strategic Assessment forecast for the year 2020 plus the extension of "30 Minute" Service from Fullerton to LAUS which brings the total number of Metrolink trains between Fullerton and Redondo Junction to 101 per day; 9 trains per day higher then the Strategic Assessment service forecast for the year 2030.

5.4 COMMON INFRASTRUCTURE / MAINLINE TRACK CONFIGURATION

The primary study area for the analysis was composed of the mainline segment of the LOSSAN Corridor between Redondo Junction and Anaheim. In addition, all passenger trains operating west of Redondo Junction were assumed to be operating either to or from LAUS. The terminal station for the HST in Orange County was assumed to be the proposed Anaheim Regional Transportation Intermodal Center (ARTIC) configured with four tracks and two platforms.

6.0 SIMULATION MODEL CASES – OPERATIONS ANALYSIS

The Model was developed to represent the service attributes and physical characteristics of the portion of the LOSSAN Corridor between LAUS and Anaheim, focusing on the mainline capacity requirements of the rail network between Redondo Junction and Fullerton, and between Fullerton and Anaheim. This section describes the conceptual track configurations and assumptions applied to each specific simulation Model Case and summarizes the results of each scenario. The Model Cases which are documented in Section 6 of this report include:

Case 1 - "Two and Two"

- ○ Total of Four Mainline Tracks from Redondo Junction to Fullerton
  - Two interconnected tracks exclusively for freight trains
  - Two interconnected tracks exclusively for passenger trains
    - "Shared use" for conventional passenger trains (Amtrak, Metrolink) and the HST
- ○ The two interconnected freight tracks and two interconnected passenger tracks are completely separated from each other with no physical connection (between the freight tracks and passenger tracks).
- ○ Two tracks from Fullerton to Anaheim
  - Passenger trains during public service hours
  - Freight trains time separated to nighttime

Case 2 - "Three and Two"

- ○ Total of Five Mainline Tracks Redondo Junction to Fullerton
  - Three interconnected tracks exclusively for freight trains
  - Two interconnected tracks exclusively for passenger trains
    - "Shared use" for conventional passenger trains (Amtrak, Metrolink) and the HST
- ○ Three interconnected freight tracks and two interconnected passenger tracks are completely separated from each other with no physical connection (between the freight tracks and passenger tracks).
- ○ Two Tracks from Fullerton to Anaheim
  - Passenger trains during public service hours
  - Freight trains time separated to nighttime

Case 3 – " Three and Two" with Shared Use

- Total of Five Mainline Tracks from Redondo Junction to Fullerton
  - Three interconnected tracks for the operation of freight trains and conventional passenger trains
  - Two interconnected tracks exclusively for passenger trains only
    - "Shared use" for conventional Metrolink trains and the HST
- The two exclusive passenger tracks for "shared use" of Metrolink and the HST are physically separated from the three tracks for combined operation of freight trains and other conventional passenger trains (Amtrak and Metrolink 91-Line).
- Dedicated passenger double track joins two tracks east of Fullerton Junction
  - Two Tracks continue to Anaheim
  - Passenger trains during public service hours
  - Freight trains time separated to nighttime

Case 4 – "Four and Two" with Shared Use and Exclusive Tracks for High Speed Train

- Total of Six Mainline Tracks from Redondo Junction to Fullerton
  - Four interconnected tracks for the operation of freight trains and conventional passenger trains
  - Two interconnected (physically separated) tracks exclusively for the HST
- The two exclusive HST tracks are physically separated from the four tracks for combined operation of freight trains and conventional passenger trains.
- Total of Four Mainline Tracks from Fullerton to Anaheim
  - Two tracks for the combined operation of freight trains and conventional passenger trains
  - Two tracks (physically separated) exclusively for the HST

Case 5 – "Four Track No-Build""

- Total of Three Mainline Tracks from Redondo Junction to Fullerton (Step 1)
  - Three interconnected tracks for the operation of freight trains, Amtrak and Metrolink.
- Total of Four Mainline Tracks from Fullerton to Anaheim (Step 2)
  - Four interconnected tracks for the operation of freight trains, Amtrak and Metrolink.

Details and results of the operations analysis associated with each one of the Model Cases outlined above are presented in the following sub-sections.

6.1 LOSSAN CORRIDOR MODEL CASE 1 – "TWO AND TWO"

Assumptions

The LOSSAN Corridor Model Case 1 assumed:

- Train Characteristics: As described in Section 5.1 for Freight trains, the HST and Amtrak plus:
  - Metrolink: AEM-7 with 5 coaches

- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 125 mph for the High Speed Train
  - Maximum speed of 110 mph for Amtrak and Metrolink trains
  - Maximum speed of 50 mph for Freight trains
- Service Level Assumptions: As described in Section 5.3 plus:
  - Total of 26 HST per Day (both directions - based on Cambridge Systematics “high level” ridership demand forecast)
    - Average of 1 HST per Hour in each direction
- Mainline Track Configuration Assumptions : As described in Section 5.4 plus:
  - Four mainline tracks between Redondo Junction and Fullerton Junction
    - Two interconnected tracks for exclusive use of freight trains
    - Two interconnected tracks for exclusive use of passenger trains
      - *Maximum Track Speed 125 mph*
      - *HST*
      - *Metrolink*
      - *Amtrak*
  - Two mainline tracks between Fullerton Junction and Anaheim
    - Freight trains time separated to nighttime operations
    - Exclusive use of passenger trains during public service hours
      - *Maximum Track Speed 125 mph*
      - *HST*
      - *Metrolink*
      - *Amtrak*

Approach

The LOSSAN Corridor - Model Case 1 (refer to Appendix A-Figure 3) examined the capacity of four mainline tracks between Redondo Junction and Fullerton Junction with two interconnected tracks designated exclusively for BNSF freight trains and two interconnected tracks designated exclusively for “shared use” among passenger trains (HST, Metrolink and Amtrak). This Case assumed a “complete” physical separation between the two interconnected freight tracks and the two interconnected passenger tracks in the Model, essentially defining two discrete, “two track systems”. Between Fullerton and Anaheim two main tracks were assumed, with freight operations time separated to nighttime hours.

Objective

The purpose of the LOSSAN Corridor – Model Case 1 was to determine, at a conceptual level of analysis, the feasibility of the assumed mainline track configuration of two, physically separated “two track systems” (total of four tracks) to provide sufficient capacity to operate the forecast levels for freight and passenger trains including the HST.

Conclusions

The results of the simulation modeling and analysis for the LOSSAN Corridor – Model Case 1 indicated that two mainline tracks could feasibly support, at a maximum, the combined forecast levels of Amtrak, Metrolink and the HST as tested in the Model which assumed that Metrolink passenger trains would have performance characteristics similar to those of the HST. It is important to note that for HST Service this configuration is severely constrained and can only support an average of one HST per hour in each direction. Based upon analysis of the Model outputs including stringline graphs (refer to Appendix B-Figures 1&2 for Freight and 3,4 &5 for Passenger) of the simulated trains, it was determined that two main tracks are not adequate to support the assumed volume of freight trains at an acceptable level of performance/delay using existing performance characteristics as the baseline..

6.2 LOSSAN CORRIDOR MODEL CASE 2 – "THREE AND TWO" (WITH EXCLUSIVE USE FOR FREIGHT & PASSENGER TRAINS)

Assumptions

The LOSSAN Corridor Model Case 2 assumed:

- Train Characteristics: As described in Section 5.1 for Freight trains, the HST and Amtrak plus:
  - Metrolink: AEM-7 with 5 coaches
- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 125 mph for the HST
  - Maximum speed of 110 mph for Amtrak and Metrolink trains
  - Maximum speed of 50 mph for Freight trains
- Service Level Assumptions: As described in Section 5.3 plus:
  - Total of 26 HST per Day (both directions - based on Cambridge Systematics "high level" ridership demand forecast)
    - Average of 1 HST per Hour in each direction
- Mainline Track Configuration Assumptions : As described in Section 5.4 plus:
  - Five mainline tracks between Redondo Junction and Fullerton Junction
    - Three interconnected tracks for exclusive use of freight trains
    - Two interconnected tracks for exclusive use of passenger trains
      - *Maximum Track Speed 125 mph*
      - *HST*
      - *Metrolink*
      - *Amtrak*

- Two mainline tracks between Fullerton Junction and Anaheim
  - Freight trains time separated to nighttime hours
  - Exclusive use of passenger trains during public use hours
    - *Maximum Track Speed 125 mph*
    - *HST*
    - *Metrolink*
    - *Amtrak*

Approach

The LOSSAN Corridor - Model Case 2 (refer to Appendix A-Figure 4) examined the capacity of five mainline tracks between Redondo Junction and Fullerton Junction with three interconnected tracks designated exclusively for BNSF freight trains and two interconnected tracks designated exclusively for the “shared use” of passenger trains; HST, Metrolink and Amtrak). As in Case 1, a “complete” physical separation between the three interconnected freight tracks and the two interconnected passenger tracks was assumed in the Model, essentially defining two discrete rail systems: one “three track system” and one “two track system”. Between Fullerton and Anaheim two main tracks were assumed, with freight operations time separated to nighttime hours.

Objective

The purpose of the LOSSAN Corridor – Model Case 2 was to determine, at a conceptual level of analysis, the feasibility of the assumed mainline track configuration of two separate rail systems; one with three interconnected tracks for freight trains, and one with two interconnected tracks for passenger trains (total of five tracks), to provide sufficient capacity to operate the forecast levels for freight and passenger trains, including the HST.

Conclusions

The results of the simulation modeling and analysis for the LOSSAN Corridor – Model Case 2 indicated that two mainline tracks could feasibly support, at a maximum, the forecast levels of Amtrak, Metrolink and HST as tested in the Model. As in Case 1, it is important to note that this configuration is severely constrained and can only support an average of one HST per hour in each direction. Based upon analysis of the Model outputs including stringline graphs (refer to Appendix B- Figures 6&7 for Freight and Figures 3, 4 &5 for Passenger) of the simulated trains, it was determined that three interconnected main tracks provide sufficient capacity to feasibly support the assumed volume of freight trains at an acceptable level of performance/delay using existing performance as the baseline.

6.3 LOSSAN Corridor Model Case 3 – “Three and Two” (with two physically separated “shared use” passenger tracks)

Assumptions

The LOSSAN Corridor Model Case 3 assumed:

- Train Characteristics: As described in Section 5.1 for Freight trains, HST and Amtrak plus:
  - Metrolink: F59PHI
    - 91-Line trains with 6 coaches

- "30 Minute" Service trains with 4 coaches
- Orange County Line trains with 8 coaches

- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 110 mph for the HST and Metrolink "30 Minute" Service and Orange County Trains
  - Maximum speed of 79 mph for Amtrak and Metrolink 91-Line Trains
  - Maximum speed of 50 mph for Freight Trains
- Service Level Assumptions: As described in Section 5.3 plus:
  - Up to 3 HST per Hour in Each Direction
- Mainline Track Configuration Assumptions : As described in Section 5.4 plus:
  - Five mainline tracks between Redondo Junction and Fullerton Junction
    - Three interconnected tracks for combined operations of:
      - *Freight Trains*
      - *Metrolink 91-Line*
      - *Amtrak*
    - Two interconnected tracks for exclusive use of passenger trains ("shared use" among the HST and Metrolink)
      - *Maximum Track Speed 110 mph*
      - *HST*
      - *Metrolink "30 Minute" Service & Orange County Line trains*
  - Two mainline tracks between Fullerton Junction and Anaheim
    - Freight trains time separated to nighttime hours
    - Exclusive use of passenger trains during public service hours
      - *Maximum Track Speed 110 mph*
      - *HST*
      - *Metrolink*
      - *Amtrak*

<u>*Approach*</u>

The LOSSAN Corridor - Model Case 3 (refer to Appendix A-Figure 5) examined the capacity of five main tracks between Redondo Junction and Fullerton Junction with three interconnected tracks shared among BNSF freight trains, Amtrak trains and Metrolink 91-Line trains and two interconnected tracks designated exclusively for passenger trains (HST and Metrolink). The concept of physically separating two tracks from the three interconnected tracks used for the combined operation of freight, Amtrak and Metrolink 91-Line trains was assumed in the Model, essentially defining two discrete rail systems; one "three track system" and one "two track system". Two mainline tracks were assumed from Fullerton to Anaheim.

Objective

The purpose of the LOSSAN Corridor – Model Case 3 was to determine, at a conceptual level of analysis, the feasibility of the assumed mainline track configuration of two separate rail systems between Redondo Junction and Fullerton; one system with three interconnected tracks for the combined operations of freight, Amtrak and Metrolink trains, and the second system, physically separated, with two interconnected tracks exclusively for the "shared use" of passenger trains (Metrolink and HST), to provide sufficient capacity to operate the forecast levels for freight and passenger trains, including the HST.

Conclusions

The results of the simulation modeling and analysis for the LOSSAN Corridor – Model Case 3 indicated that two interconnected mainline tracks are capable of supporting, the forecast levels of Metrolink "30 Minute" Service and up to 3 HST per hour in each direction. The potential to operate 4 HST per hour may be examined should this concept be carried forward for further study. Based upon analysis of the Model outputs including stringline graphs (refer to Appendix B-Figures 8,9 &10) of the simulated trains, it was determined that three main tracks could feasibly support the assumed volume of freight trains plus forecast Metrolink 91-Line and Amtrak trains at an acceptable level of performance/delay using existing performance as the baseline. In addition, it was determined that the potential need for a third track between Fullerton and Anaheim be examined should this concept be carried forward for further study.

6.4 LOSSAN CORRIDOR MODEL CASE 4 – "FOUR AND TWO" (WITH SHARED USE)

Assumptions

The LOSSAN Corridor Model Case 4 assumed:

- Train Characteristics: As described in Section 5.1 for Freight trains, HST and Amtrak plus:
  - Metrolink: F59PHI
    - 91-Line Trains with 6 coaches
    - "30 Minute" Service trains with 4 coaches
    - Orange County Line trains with 8 coaches
- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 125 mph for the HST
  - Maximum speed of 79 mph for Amtrak and Metrolink trains
  - Maximum speed 50 mph for Freight trains
- Service Level Assumptions: As described in Section 5.3 plus:
  - 6 HST per Hour in each direction
- Mainline Track Configuration Assumptions : As described in Section 5.4 plus:
  - Six mainline tracks between Redondo Junction and Fullerton Junction
    - Four interconnected tracks for the combined operation of:
      - *Freight*
      - *Metrolink*
      - *Amtrak*

  - Two interconnected tracks for exclusive use of the HST
- Four mainline tracks between Fullerton Junction and Anaheim
  - Two Tracks for "Shared Use"
    - *Maximum Track Speed 79 mph*
    - *Freight*
    - *Metrolink*
    - *Amtrak*
  - Two Tracks for exclusive use of the HST

Approach

The LOSSAN Corridor - Model Case 4 (refer to Appendix A-Figure 6) examined the capacity of six mainline tracks between Redondo Junction and Fullerton Junction with four interconnected tracks shared among BNSF freight trains, and conventional passenger trains; Amtrak and Metrolink. Two interconnected tracks physically separated from the other four tracks were assumed in the Model for the HST, essentially defining one four track system and one two track system". From Fullerton to Anaheim, four main tracks are assumed; two tracks for shared use and two tracks for the dedicated HST line.

Objective

The objective of the LOSSAN Corridor – Model Case 4 was to determine, at a conceptual level of analysis, the feasibility of the assumed mainline track configuration (six tracks) to provide sufficient capacity to operate the forecast levels for freight and passenger trains, including the HST.

Conclusions

The results of the simulation modeling and analysis for the LOSSAN Corridor – Model Case 4 indicated that two "dedicated" mainline tracks could feasibly support, 12 HST per hour (both directions). Based upon analysis of the Model outputs including stringline graphs (refer to Appendix B-Figures 11& 12 for shared use; Figures 13 & 14 for the HST express; Figures 15 & 16 for the HST with one stop) of the simulated trains, it was determined that four interconnected main tracks provide sufficient capacity to feasibly support the assumed volume of freight trains plus forecast Metrolink and Amtrak trains at an acceptable level of performance/delay using existing performance as the baseline. It should be noted that even though the analysis tested the operation of 6 HST per hour in each direction on the dedicated, double track, HST line, there is significant unused main track capacity which could potentially support up to 20 trains per hour in each direction if the signal system were designed to support 3 minute practical headways. Metrolink trains could also be operated on the dedicated tracks to utilize some portion of available capacity. In addition, the analysis of this Case indicated that a maximum speed of 150 mph for the HST is not practical because the train cannot achieve this speed due to a service assumption that includes one station stop between LAUS and Anaheim (either direction), and the geometric attributes of the alignment that constrain speed. Furthermore, it was determined that the because the difference in trip time when comparing a maximum speed of 150 mph and 125 mph is only five seconds (and twenty-six seconds comparing 125 mph and 110 mph), it may be prudent to consider other factors such as capital investment and operations and maintenance costs as studies move forward and prior to adopting a "final" criteria for maximum operating speed. Based on results thus far, a maximum speed of 125 mph is recommended for the HST.

6.5 LOSSAN CORRIDOR MODEL CASE 5 – "FOUR TRACK NO BUILD"

Assumptions

The LOSSAN Corridor Model Case 5 assumed:

- Train Characteristics: As described in Section 5.1 for Freight trains and Amtrak plus:
  - Metrolink: F59PHI
    - 91-Line Trains with 6 coaches
    - "30 Minute" Service trains with 4 coaches
    - Orange County Line trains with 8 coaches
- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 79 mph for Amtrak and Metrolink trains
  - Maximum speed 50 mph for Freight trains
- Service Level Assumptions: As described in Section 5.3:

Freight Trains

As described earlier in this report, BNSF currently operates up to ninety freight trains per day between Redondo and Fullerton Junctions, and for purposes of this study, growth was assumed to be at a rate of two percent per year over a twenty year period between 2007 and 2027. The results of applying this growth factor yielded a total of 133 freight train movements per day on this segment of the Corridor; this is the volume of trains that was consistently assumed in the simulation Cases. The freight train movements, by train type and time of day, were patterned on the basis of existing operations.

Conventional Passenger Trains

Conventional passenger service currently operating within the study area (of the LOSSAN Corridor) includes Metrolink commuter and Amtrak intercity trains. The future service levels assumed in each of the simulation Model cases are summarized in Figure 6.3.1 and compared to existing service plans.

Figure 6.3.1: Conventional Passenger Trains per Weekday

Service	Current	Future/Modeled
Amtrak Pacific Surfliner	22	32
Amtrak Long Distance	2	2
91 Line: LA-Riverside	9	24
91 Line: LA-Perris	-	
LAUS-Oceanside	10	10
LAUS-Laguna Niguel	9	67
Fullerton-Laguna Niguel	-	
*IEOC	16	26

**Noted but not included in the simulation Model study area which ends at Anaheim*

- The Metrolink future service levels are based on the Metrolink Strategic Assessment published in January 2007. These future service levels include the Strategic Assessment forecast for the year 2020 plus the extension of "30 Minute" Service from Fullerton to LAUS which brings the total number of Metrolink trains between Fullerton and Redondo Junction to 101 per day; 9 trains per day higher then the Strategic Assessment service forecast for the year 2030.

○ Mainline Track Configuration Assumptions:

- Three mainline tracks between Redondo Junction and Fullerton Junction (step one to examine the capacity of three mainline tracks)
  - Three interconnected tracks for the combined operation of:
    - *Freight*
    - *Metrolink*
    - *Amtrak*
- Four mainline tracks between Redondo Junction and Fullerton Junction (step two to examine the capacity of four mainline tracks)
  - Four interconnected tracks for the combined operation of:
    - *Freight*
    - *Metrolink*
    - *Amtrak*
- Two mainline tracks between Fullerton Junction and Anaheim
    - *Maximum Track Speed 79 mph*
    - *Freight*
    - *Metrolink*
    - *Amtrak*

Approach

Step one in the analysis of LOSSAN Corridor - Model Case 5 (refer to Appendix A-Figure _) examined the capacity of three mainline tracks between Redondo Junction and Fullerton Junction with these three tracks interconnected and shared among BNSF freight trains, Amtrak and Metrolink.

Step two in the analysis of LOSSAN Corridor – Model Case 5 (refer to Appendix A-Figure _) examined the capacity of four mainline tracks between Redondo Junction and Fullerton with these four tracks interconnected and shared among BNSF freight trains, Amtrak and Metrolink.

Objective

The objective of the LOSSAN Corridor – Model Case 5 was to determine, at a conceptual level of analysis, the feasibility of the assumed mainline track configuration with three tracks, to provide sufficient capacity to operate the forecast levels for BNSF freight, Amtrak and Metrolink trains.

Conclusions

The results of the simulation modeling and analysis for the LOSSAN Corridor – Model Case 5 indicated that three mainline tracks did not provide sufficient capacity for the forecast level of freight and passenger trains. Based upon analysis of the Model outputs including stringline

graphs (refer to Appendix B-Figures 17 & 18) of the simulated trains, it was determined that three main tracks are not adequate to support the assumed volume of freight trains plus forecast Amtrak and Metrolink service modeled, at an acceptable level of performance/delay using existing performance characteristics as the baseline..

Based upon analysis of the Model outputs including stringline graphs (refer to Appendix B-Figures 10 & 13) of the simulated trains, it was determined that four interconnected main tracks provide sufficient capacity to feasibly support the assumed volume of freight trains plus forecast Metrolink and Amtrak trains at an acceptable level of performance/delay using existing performance as the baseline.

7.0 MODEL CASE 3 – WITH ADDITIONAL ALIGNMENT ALTERNATIVES AND HST SAN DIEGO SERVICE

Based on the results of the simulations and operational analysis presented in Section 6.3 (above), the "LOSSAN Corridor Model Case 3 – "Three and Two" (With two Physically Separated 'Shared Use' Passenger Tracks)" was selected for further analysis to include not only the HST service operating to/from LAUS and Anaheim but also to consider the HST service operating to/from LAUS and San Diego on the mainline LAUS "approach" segment between Redondo Junction and LAUS. In addition, this analysis included an update on the characteristics of the alignment segment between Redondo Junction-Fullerton-Anaheim and examined the four alignment concept alternatives for the HST "approach" segment between Redondo Junction and LAUS that were developed by the Regional Team. Both the update to the segment between Redondo Junction-Fullerton-Anaheim and the (four) alignment concept alternatives (Redondo Junction to LAUS) were coded into the LOSSAN Corridor model. Each alignment alternative scenario was simulated to identify differences in HST travel times and evaluate capacity and potential operational impacts associated with shared track operations of HST and Metrolink trains between Redondo Junction and Anaheim, and all of the HST between Redondo Junction and LAUS (only HST service to/from LAUS and Anaheim and to/from LAUS and San Diego would operate on this segment).

The assumptions used in the model were based on those presented previously in Section 5.0 with some minor modifications made to the assumptions presented in Section 6.3, which are described below.

- Train Characteristics: Train performance characteristics were consistent with those described in Section 5.1 , with the following exceptions:
  - Metrolink:
    - All Metrolink trains are powered by MotivePower MP40 locomotives
    - Metrolink lines operating within Orange County and along the LOSSAN Corridor were incorporated using the following consist modifications.
      - 91-Line trains: One locomotive and 6 coaches
      - IEOC Line trains: Two locomotives and 8 coaches
      - Orange County Line trains: Two locomotives and 8 coaches
      - Orange County "30-minute" trains: One locomotive and 6 coaches

- Operating Assumptions: As described in Section 5.2 plus:
  - Maximum speed of 125 mph for the HST

- Maximum speed of 95 mph for Metrolink Orange County Line trains along shared HST segments.
- Maximum speed of 79 mph for Amtrak and Metrolink 91-Line Trains between Los Angeles and Fullerton.
- Maximum speed of 90 mph for Amtrak between Fullerton and Anaheim, maximum speed of 79 mph between Anaheim and Santa Ana, and maximum speed of 90mph for Amtrak between Santa Ana and Laguna Niguel.
- Maximum speed of 50 mph for Freight Trains between Redondo Junction and Fullerton.

○ Service Level Assumptions: As described in Section 5.3 plus:

- Up to 4 HST per Hour in Each Direction between LAUS and Anaheim
- Up to 14 HST per Hour in Each Direction between LAUS and San Diego

○ Mainline Track Configuration Assumptions : As described in Section 5.4 plus:

- Two HST mainline tracks between Redondo Junction and LAUS
  - “Approach” tracks to LAUS for exclusive operation of the HST services between:
    - Anaheim and LAUS
    - San Diego and LAUS
  - Four alignment options examined.
    - Alignment 1 – From east to west, this alignment leaves the existing railroad right-of-way and HST corridor just east of Redondo Junction on an aerial structure. The alignment cuts geographically north of the existing flyover, where it crosses the Los Angeles River before following the existing railroad right-of-way along the west bank of the river up to 4th Street, where the alignment then diverts geographically west, away from the river, and into LAUS after crossing over US 101. (refer to Appendix A-Figure 7)
    - Alignment 2 – From east to west, this alignment leaves the existing railroad right-of-way and HST corridor just west of Hobart Yard and cuts geographically north of Alignment 1 before crossing the Los Angeles River. Similar to Alternative 1, this alignment then follows the west bank of the river up to between 6th and 7th Streets, where the alignment diverts geographically west, away from the river, and into LAUS after crossing over US 101. This alignment straightens the “S” configuration arriving and departing LAUS that is presented under alignment 1. (refer to Appendix A-Figure 8)
    - Alignment 3 – From east to west, this alignment From east to west, this alignment leaves the existing railroad right-of-way and HST corridor at the same location as Alternative 1, however this alignment does not follow along the west bank of the Los Angeles River. This alignment travels geographically west of the river beginning near Olympic Boulevard, then turning geographically north into LAUS after crossing over US 101. (refer to Appendix A-Figure 9)
    - Alignment 4 – From east to west, this alignment leaves the existing railroad right-of-way and HST corridor just east of Redondo Junction on an aerial structure. The alignment cuts geographically north of the existing flyover, where it crosses the Los Angeles River before following the existing railroad right-of-way along the

west bank of the river. This alignment differs from the previous 3 alternatives in that it assumes a HST terminal along the river and not at the existing LAUS terminal. (refer to Appendix A-Figure 10)

- Commonalities between all alignment configurations include:
  - Junction with HST alignment to/from San Diego occurs east of the Los Angeles River crossing and west of Hobart Yard.
  - Junction with existing Metrolink alignment to/from LAUS occurs just east of junction with San Diego HST alignment, but also between Hobart Yard and the crossing of the Los Angeles River.

- Five mainline tracks between Redondo Junction and Fullerton Junction
  - Three interconnected tracks for combined operations:
    - *BNSF Freight Trains*
    - *Metrolink 91-Line*
    - *Amtrak Pacific Surfliner and Southwest Chief*
    - *Maximum Track Speed of 79 mph for passenger and 50mph for freight*
  - Two interconnected tracks for exclusive use of passenger trains (“shared use” among the HST and Metrolink)
    - *Maximum Track Speed of 125 mph*
    - *HST*
    - *Metrolink Orange County Line trains 95 mph*
- Two mainline tracks between Fullerton Junction and Anaheim
  - Freight trains are time separated and assumed to operate only during nighttime hours
  - Exclusive use of passenger trains during public service hours
    - *Maximum Track Speed of 110 mph*
    - *HST*
    - *Metrolink Orange County Trains 95 mph*
    - *Amtrak Pacific Surfliner Trains 90 mph*

Objective

The purpose of further operational analysis for the LOSSAN Corridor – Model Case 3 was to identify the operational differences between the four alternative alignments developed for the approach into LAUS for HST assuming the operating assumptions previously outlined and to determine the maximum number of HST that could be accommodated between Redondo Junction and LAUS when HST service arriving from and departing to both Anaheim and San Diego are considered.

In addition, this operational analysis tested the operational effectiveness of updates made to the conceptual alignment between Redondo Junction-Fullerton-Anaheim.

Conclusions

The results of the simulation modeling and analysis for the four alternative alignments developed for the LOSSAN Corridor – Model Case 3 are presented below in three parts: comparison of travel times, capacity analysis, and potential conflicts.

1. Comparison of Travel Times – Travel times were obtained as an output of the model for a representative HST operating both westbound and eastbound for all four alternatives. The travel times were presented on the Train Performance Calculator (TPC) charts, which assumed one stop in Norwalk for all HS trains traveling east and west.

   The difference in the performance of the HST between the alternatives varied slightly, with the variance being no more than 16 seconds (the difference between Alignment 1 and 3) between alternatives.

2. Capacity Analysis – A full dispatch simulation was performed for a typical weekday for each alternative that incorporated the train volumes identified in Table 5.3.1. Based upon analysis of the Model outputs, including stringline graphs of the simulated trains, it was determined that up to 4 HST and 4 Metrolink trains could be operated per hour in each direction, east of Redondo Junction to Anaheim (along the Redondo Junction-Fullerton-Anaheim segment of the two dedicated passenger tracks). This is one more additional roundtrip HST per hour than was identified in the original analysis conducted for this operating scenario (presented in Section 6.3). Given the speed differential between Metrolink and HST, HST were modeled to overtake Metrolink trains periodically during peak period operations at Buena Park (westbound) and Fullerton (eastbound).

   West of Redondo Junction, Metrolink trains operated on the existing alignment and HST continued into a new HST terminal at LAUS via one of the four (alternative) “approach” alignments described previously. A section of HST alignment from San Diego was modeled and joined the corridor near Redondo Junction. This HST line intersection,, as depicted in the concept developed by the Regional Team, occurs north of the junction for Metrolink trains so as not to present conflicts between Metrolink trains and the HST San Diego Line service. The interaction between HST traveling between LAUS and San Diego and those traveling between LAUS and Anaheim were modeled to determine the level of operations that could be supported along the HST alignment arriving to and departing from Los Angeles. Reviewing the model outputs, it was determined that up to 14 HST an hour to/from San Diego could be operated jointly with up to 4 HST an hour operating to/from Anaheim.

3. Potential Conflicts – For the segment of the Corridor between Fullerton and Anaheim, it is important to recognize that the on-time performance of Amtrak Pacific Surfliner trains needs to be at a consistently higher level than typical existing conditions to ensure that trains arriving from east of Anaheim and from west of Fullerton are on-time in order to make their “operating slots” between the Metrolink trains and HST. On several occasions in the model, Amtrak trains were observed being delayed in San Diego County as a result of the numerous locations of single track along the Corridor, or along the BNSF as a result of conflicts with freight trains. As a result of this delay, Amtrak trains were slotted in close sequence to the

HST and on occasion appeared to cause minimal delays to the HST. The delay was did not exceed two minutes and the network operation was observed to recover relatively quickly.

8.0 "CROSS-PLANT" FREIGHT TRAIN MOVEMENTS

8.1 BACKGROUND

The operation of the HST between LAUS and Anaheim is assumed to occur along the existing railroad right-of-way of the LOSSAN Corridor. Therefore, it is important to understand the complexity and size of the local freight operations provided by both the UPRR and BNSF Railway between Redondo Junction and Fullerton Junction, in addition to the long distance freight trains. Understanding the dynamics of these local freight movements, or "cross-plant" movements, and how they relate to the complex operating conditions inherent on the LOSSAN Corridor is a significant priority. .

Consequently, a study of the "cross plant" freight train movements (which were referred to in Section 2.1 of this report), was conducted to provide additional details associated with these types of mainline track occupancies occurring on the LOSSAN Corridor between LAUS and Fullerton. This study describes the type and nature of the "cross-plant" freight train movements in this critical segment of the Corridor, and examines the process of developing solutions that support a LOSSAN Corridor configuration that does not preclude the addition of the HST. This section of the report presents a clear understanding of these "cross-plant" freight train movements

8.2 DATA COLLECTION

A research process was conducted to assemble and document "real time" data reflecting existing operational conditions on the LOSSAN Corridor between Redondo Junction and Anaheim. First hand observations of trains dispatched on this segment of the Corridor were observed and recorded in the Metrolink Operations Center (MOC) for a one-week period (five weekdays and two weekend days); in several cases, these train movements were also observed and further verified in the field. The data collected on freight trains during this multi week review period included both long-distance and local "cross-plant" freight train movements.

8.3 DEFINITION

For purposes of this discussion, mainline track occupancy is considered a "cross-plant" freight train movement if it operates on the LOSSAN Corridor mainline tracks and traverses across the mainline from a yard on one side of the Corridor to a yard on the other These train movements occur primarily in three "zones", which are illustrated in Appendix A-Figure 2.

1. Zone 1 - In proximity to the eastern end of the section of the LOSSAN Corridor between La Mirada Yard and the siding at Basta
2. Zone 2 - South of the mainline in the Hobart Yard area, including the Autoveyor Yard, Eastern Avenue siding, and Commerce Yard
3. Zone 3 - The tracks and sidings located west and south of CP Soto along the mainline and the BNSF 1st Street Yard.

In addition, a train movement routed across the mainline using a diamond crossover is likewise classified as a "cross-plant" move. Specifically, three diamond crossovers are noted in the study: 1.) between CP Soto and Fullerton at San Pedro Junction just east of Soto; 3.) at DT Junction east of Pico Rivera; 3.) at Los Nietos approximately one mile east of DT Junction. These diamond crossover tracks are used by the Union Pacific Railroad to traverse the BNSF mainline.

8.4 METHODOLOGY

As previously noted, freight train movements in the LOSSAN Corridor were observed and documented over a seven day period and supplemented by several days of visual observations in the field. The data was organized in a format similar to that used daily by train dispatchers to record the movement of each train; the entry point and time on the Corridor mainline, and the time it passed successive specified "timing" locations, up to and including the time it stopped the movement or departed the mainline track. The data was then reviewed and those events which met the criteria for "cross-plant" freight train movements were identified, extracted and collated.

Following this step, the data associated with the "cross-plant" freight train movements was further organized into four discrete categories of trains, which include:

1. Road Freight Train – these trains deliver large "blocks" or groups (coupled together) of freight cars from one major terminal to another major terminal.
2. Local Freight Train – these deliver freight cars from a major terminal to/from smaller yards, industrial yards, and freight consignees.
3. Yard and Extra Freight Train – these include trains that move freight cars within and between adjacent yards, including shop cars and locomotives. (an extra train is assigned to this category if it was not designated with a conventional train symbol and met this movement definition).
4. Union Pacific RR Freight Train Using a Diamond Crossover – a UPRR train that operates northbound or southbound across the LOSSAN mainline at one of the three specified diamond crossover locations.

8.5 ANALYSIS OF CROSS-PLANT FREIGHT TRAIN MOVEMENTS (WEEKDAY)

As displayed in Table 8.5.1 (below), during the study period the total number of "cross-plant" freight train movements was 150 for a typical weekday with a peak volume of 39 on Wednesday and a low volume of 18 on Friday. The level of activity for the different train types spanning the five weekdays were statistically in a close range at 33, 35 and 36 train movements each for Road Freight Trains, Local Freight Trains and UPRR Diamond Movements respectively; the weekly aggregate for Yard/Extra Train movements were the highest category at 46 trains over the five day period.

Table 8.5.1: Weekday Train Frequency

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Road Freight Trains	6	7	10	7	3	33
Local Freight Trains	8	8	5	10	4	35
Yard/Extra Trains	7	9	16	9	5	46
UPRR Movements	7	8	8	7	6	36
Total	28	32	39	33	18	150

The data further indicated that overall, as shown in Table 8.5.2 (below), these "cross-plant" movements occur most frequently in proximity to Hobart and Commerce Yards (46) and La Mirada Yard (42). The lowest level of activity was associated with Road Freight Train movements on the west end of the Corridor segment.

Table 8.5.2: Cross-Plant Moves by "Zone" Locations

	BNSF Yard/Soto	Hobart / Commerce Yard	La Mirada Yard	Total
Road Trains	13	9	11	33
Local Trains	0	4	31	35
Yard/Extra Trains	13	33	0	46
Total	26	46	42	114

** Does not include UP cross diamond movements.*

Road Freight Trains

As illustrated in Table 8.5.1 (above), during the study period the total number of "cross-plant" Road Freight Train movements for a typical week was 33, with a peak volume of 10 on Wednesday and a low volume of 3 on Friday.

It is noteworthy, as shown in Table 8.5.2 (above), that the "cross-plant" movements for Road Freight Trains occur most frequently at the west end of the corridor (13 movements), specifically west of Soto, where these trains traverse across the tracks to Mainline #4 or are routed west to BNSF's 1st Street Yard, which located beyond the Redondo Junction flyover towards LAUS. The second largest frequency of Road Freight Train "cross-plant" moves is found in the La Mirada/ Basta "zone" (11 movements) at the eastern end of the study area.

Local Freight Trains

As shown in Table 8.5.1 (above), Local Freight Trains in this study totaled thirty-five "cross-plant" movements for the weekday timeframe, slightly more than Road Freight Trains. The high and low volumes were respectively, 10 on Thursday and 4 on Friday.

The geographical distribution of "cross-plant" freight train movements in Table 8.5.2 demonstrates a high volume of trains of this category in the La Mirada/Basta "zone" (33). This indicator is reflective of the operating function of La Mirada Yard, which supports a large number of local rail freight customers, further evidenced by the expanse of industrial tracks and sidings adjacent to and south of the yard. This yard also supports the customer base east of La Mirada on the San Bernardino and the Orange subdivisions.

Yard/Extra Trains

The data gathered on the Yard/Extra Trains indicated that this category had the highest total frequency of "cross-plant" movements (46), more than thirty percent greater than the Road (33) or Local Train (35) categories. This is due, in part, to the range of the work rules for yard crews, which allow them more flexibility to perform various types of switching and train movement functions. It is also noteworthy that the switching activities associated with this category typically support the functional requirements of two out of three facilities at the western end of the corridor, specifically HobartYard, Commerce /Autoveyor Track, and the BNSF 1st Street Yard; this "zone" is characterized by frequent small switching movements.

UPRR Diamond Movements

The data pertaining to the UPRR Diamond "cross-plant" Movements across the Corridor presented a predictable and reasonably balanced statistical profile, averaging about 7 per day. The total weekly volume of trains (36) was close to that of the Road and Local Freight Train movement activity level noting that the UPRR Diamond Movements occur consistently at three "fixed" locations and the frequency at these three locations was evenly balanced. Of the 36

UPRR Diamond “cross-plant” freight train movements, 12 occurred at San Pedro Junction, 12 at DT Junction and 12 at Los Nietos.

8.6 ADDITIONAL INFORMATION

Time of Occurrence for Cross-plant Movements

Recognizing that the “cross-plant” freight train movements occur at various times throughout a typical weekday, the data presented in Table 8.6.1 (below) provides an indication of the time(s) of day when a higher number of freight trains are found. This data is displayed in eight, three-hour intervals and describes the number of each “cross plant” train movement within each category as they occur during the three-hour intervals. It is important to note that this distribution of trains reflects the sensitivity to the dynamic of the “shared use” between freight and passenger services on this segment of the Corridor; the timeframes between 12:00 AM and 6AM, 9:00 AM and 3:00 PM, and 6:00 PM and 12:00 AM, reveal a high volume of “cross-plant” moves. Respectively, the “cross-plant” moves in these three, six-hour intervals are 47, 40, and 46. They represent a significant portion of the defined passenger “off peak” service period. The two three-hour intervals in between reflect a reduction in the “cross-plant” moves in order to provide for the peak period passenger train operations that occur between LAUS and Fullerton.

Table 8.6.1: Frequency of Cross-Plant Movements by Time of Occurrence

Time Intervals	Road	Local	Yard/Extra	UPRR	Total
12:00am – 3:00am	3	11	8	7	29
3:00am – 6:00am	3	5	7	3	18
6:00am – 9:00am	5	0	2	1	8
9:00am – 12:00pm	7	8	3	7	25
12:00pm – 3:00pm	5	4	3	3	15
3:00pm – 6:00pm	1	1	3	4	9
6:00pm – 9:00pm	6	0	5	8	19
9:00pm – 12:00am	3	6	15	3	27

Classification of Priority Freight Trains

The BNSF Railway provides a wide range of freight service along the LOSSAN Corridor. Most freight operators have identifications assigned to various trains that repeatedly serve between particular origins and destinations. These identifications are typically categorized by priority and are very useful for understanding the BNSF’s operation along the LOSSAN Corridor. Trains that have a “Q” or a “Z” affixed to the train symbol are operating as the BNSF’s priority trains for train movement purposes. These trains are often the truck-trains, trail van trains, or container trains, and are intended to operate at a high maximum authorized speed. After these in priority are the “S” (stack) trains, the “V” (vehicle or auto) trains, followed by the “M” (manifest) trains, which are likely to carry the mixed freight and assorted commodities in the various types of freight cars such as boxcars, tank cars, covered hoppers, etc. These “M” trains generally do not operate with any priority in main track territory, and are moved behind trains of greater priority.

Functionality of the Yard Facilities along the LOSSAN Corridor

Hobart Yard toward the west end of the corridor is a major rail container operation in the Los Angeles region. It receives and dispatches road trains everyday and is supported by storage tracks and sidings across the LOSSAN Corridor in order to maintain a high rate of efficiency.

Empty container cars, commonly referred to as “bare tables”, are stored throughout the corridor between Los Angeles and San Bernardino and are retrieved as needed to support Hobart Yard. Along the corridor between Los Angeles and Fullerton, they are placed in the 1st Street Yard, north side storage tracks east of Norwalk Station, south side tracks east of Basta, and north side tracks west of Fullerton Station, to name a few locations.

Hobart Yard is also supported by the BNSF Commerce locomotive servicing facility located east of Hobart Yard and across the mainline from the Commerce Metrolink station. This facility however does not provide maintenance to the locomotives and is designed exclusively for storage of locomotives and for fueling. Hobart can be characterized as the central point for freight activity on the LOSSAN Corridor. In addition to its own freight container operation, its operations center appears to direct and support the operations to the south of the main track in the Autoveyor Facility, Eastern Avenue Siding, and Commerce locomotive facility. Frequent yard movements shuttle back and forth across the main track from Hobart to these locations, and there are routine freight movements shifting in to and out of these facilities in brief moments on and off the mainline, in between the passage of regular trains. This support is clearly a major source of the cross-plant movements.

Approximately five miles east of Hobart Yard and to the north side of the Main track is Pico Rivera. It is a smaller yard facility that, at one time, was the industrial yard which supplied and supported a major automotive assembly plant around the clock. The plant is gone now and the yard is still in use but in a much diminished capacity. Most of the “manifest” freight appears to move through La Mirada Yard now. As a result the Pico Rivera facility may offer opportunity for some different alternatives in attempting to address the cross-plant move issue. However the length of the yard tracks, and therefore capacity, is limited compared to La Mirada because the Pico Rivera Yard is located between the Rio Honda River and the grade separation at Rosemead Boulevard.

Eight miles to the east of Pico Rivera and just south of the main track is La Mirada Yard, comprised of two small adjacent industrial yards connected by a lead track offering nearly a mile in length and about thirteen tracks for switching and storing cars. This facility is a signup and start-out point for BNSF crews. Road trains routinely deliver cars or blocks of cars to La Mirada, and the train dispatchers commonly put a road train into La Mirada to temporarily store the train off of the main track when no other space is available west of La Mirada. Local trains also go on duty there and operate their trains to customers’ sidings in and around the yard and will also travel up and down the mainline to distant customers as well. There is a web of industrial tracks and sidings connected to the yard and it appears that a number of them are active.

Other noteworthy facilities are the long sidings located east of Norwalk Station on the north side of the main, two tracks west of Basta to the north and a single track east of Basta to the south side, and west of Fullerton Station to the north. These tracks are able to store perhaps hundreds of empty container flat cars, bare tables or other freight until they are needed at Hobart Yard. On the west end of the LOSSAN Corridor, west of Redondo Junction and south of the mainline, the BNSF 1st Street Yard provides additional storage space for empty container cars within close access to Hobart Yard.

8.7 SUMMARY

The study of cross-plant moves is integral to the future success of high speed rail service on the LOSSAN Corridor. It is a constant in the freight operation on this corridor, caused by the demands and needs of service and the necessity for flexibility in providing the most reliable and efficient freight operations The data gathered and presented in this section reflect that while these movements do not dominate the operating practices, they are a routine occurrence and, for this test period, they typically occur about thirty times a day and mostly in three service zones. On a typical day about thirty percent of the mainline train moves are cross-plant.

8.8 RECOMMENDATION

From this analysis, it is clear that the cross-plant operations that occur along the BNSF are an integral and significant component of the daily freight operations along the LOSSAN Corridor. The future of HST operations on the LOSSAN Corridor is dependent upon the development of an operating strategy that creates complete separation between these LOSSAN freight movements and the high-speed trains.

The purpose of this section is to present several possible recommendations for addressing and incorporating the cross-plant movements identified above into the HST system development. The specifics on the operational coordination and alignment designs presented as part of these recommendations can be refined throughout the preliminary engineering process. These recommendations include:

Grade Separation of HST and Freight Alignments

This engineering alternative represents the certain and, in all likelihood, the most expensive option. Because of the complexity of the cross-plant movements in the Hobart/Commerce Yard zone, defined by both the frequency, the type of movements, and the routine occupancy of the main track, grade separation between the freight and HST operations in this vicinity should be a serious consideration.

The facility at La Mirada Yard has a more basic relationship with the mainline track in that the road and local freights move to and from the yard while spending virtually no “dwell time” on the main except for passing through. This differs from switching activities in the area of the Autoveyor and Commerce Yard leads where the yard movements sometimes occupy the main track for extended periods. If grade separation from the main to La Mirada Yard is feasible, “cross-plant” moves could be remediated from this zone.

Relocation/Consolidation of Facilities and/or Operations

Certain freight facilities provide important but site-specific functions. The storage of “bare tables” at various facilities and sidings to support Hobart Yard is one such function, and the movement of these to the BNSF 1st Street Yard creates routine “cross-plant” moves. These could be eliminated if additional storage tracks within reasonable distance of Hobart Yard could be identified or constructed north of the main track for this function. Pico Rivera is one such facility that may be underutilized at this time, and could be converted to this function.

The relocation of consignee facilities should also be considered as an option for eliminating “cross-plant” movements. Freight consignees currently located on the south side of the main track could begin the planning process to locate a functional facility to the north side that serves their interest and meets the need of HST service. Future consignees should be engaged and directed to facilities with the same potential and operational benefits.

Assessment of Alternative Freight Routes

The three UPRR diamond crossovers on the LOSSAN Corridor are a clear obstacle to the HST operations. Grade separation is an obvious solution at these locations, but it is a costly fix. It is clear that the UP operates trains across these routes because they provide the more favorable route to the intended destinations. However there may be alternative routes that connect to the trackage south of the LOSSAN Corridor and are or could be accessible via tracks that bypass the corridor. A careful review of the freight rights-of-way throughout the territory west and south of the LOSSAN Corridor should be conducted to determine if there is potential for routing alternatives to the diamond crossovers.

Appendix A
Network Schematics

Figure 1 - LOSSAN Corridor Existing Conditions

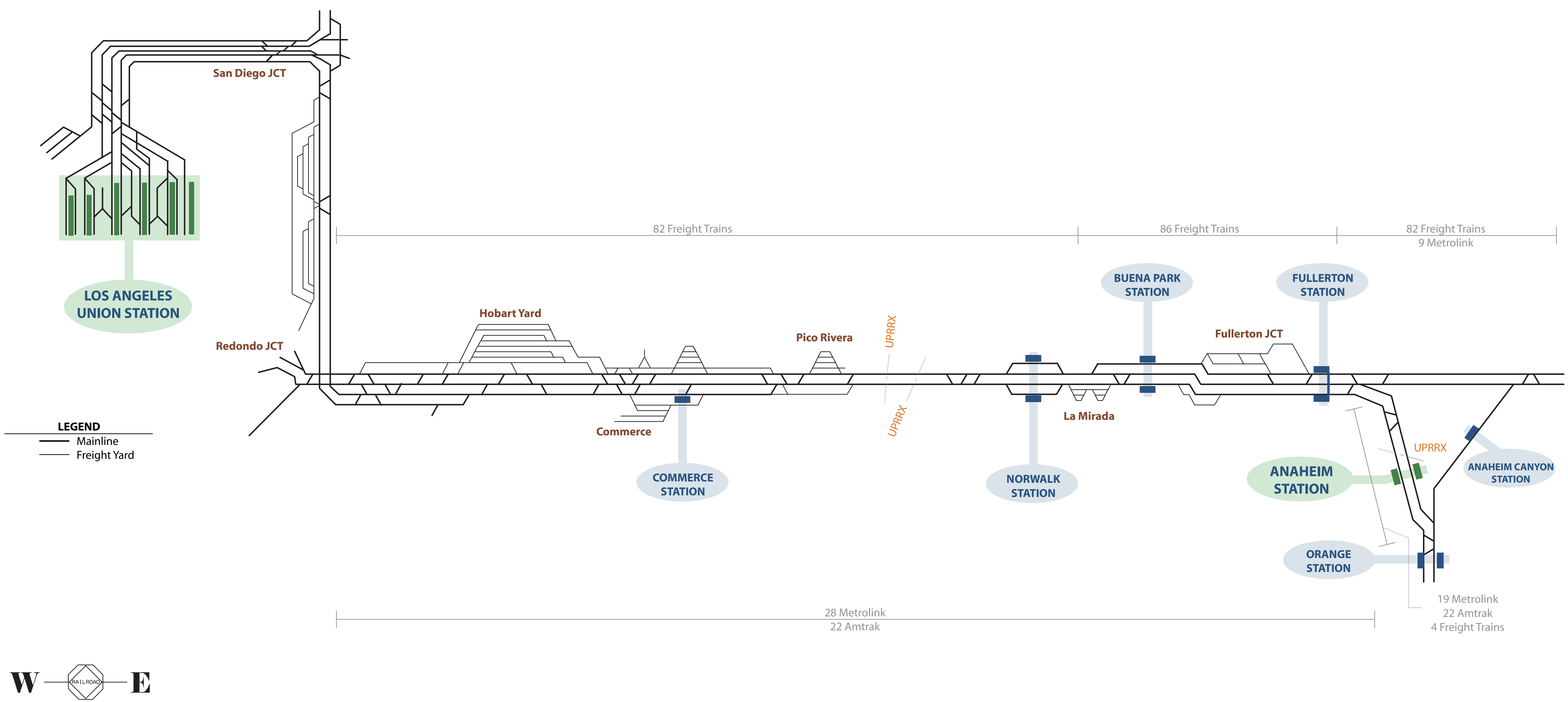


Figure 2 - LOSSAN Corridor Cross Plant Train Movement

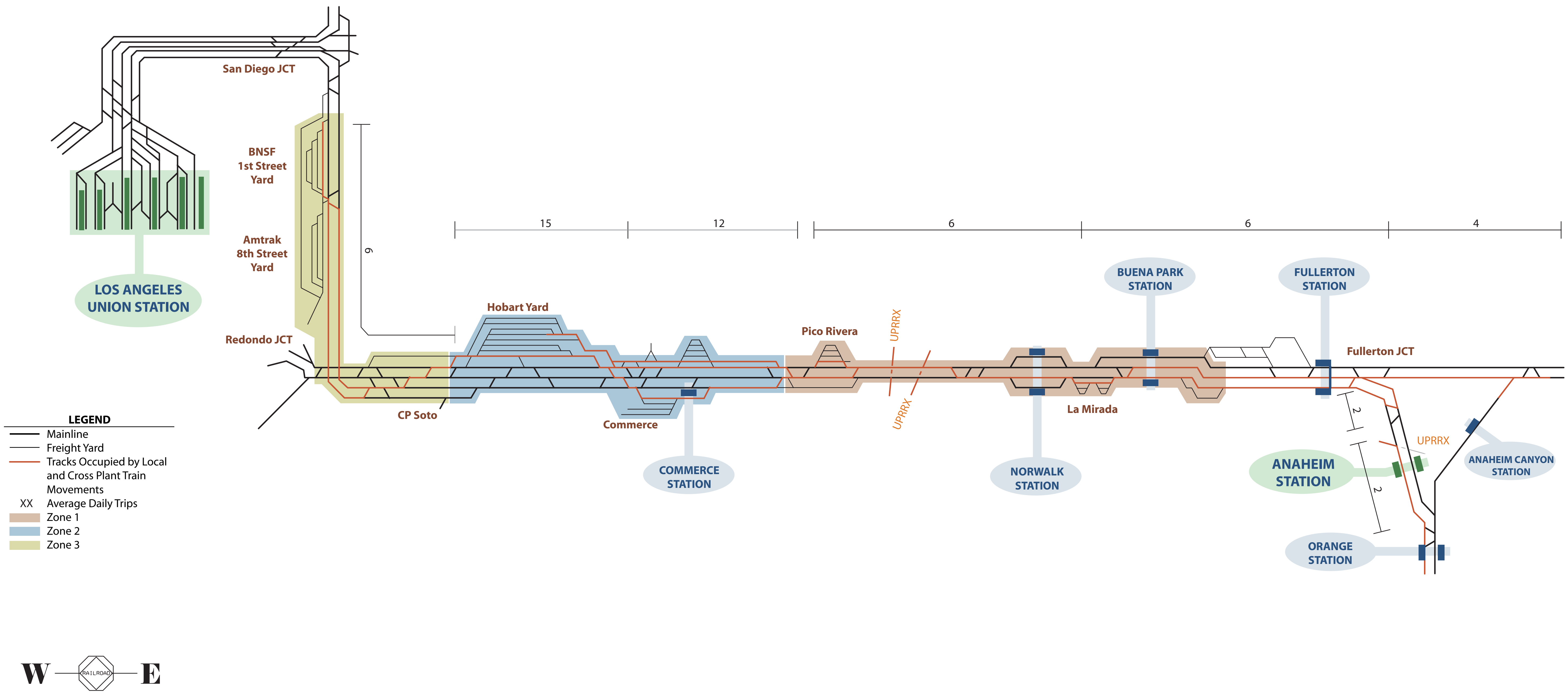


Figure 3 - LOSSAN Corridor Model Case 1 - Two and Two (with Exclusive Use)

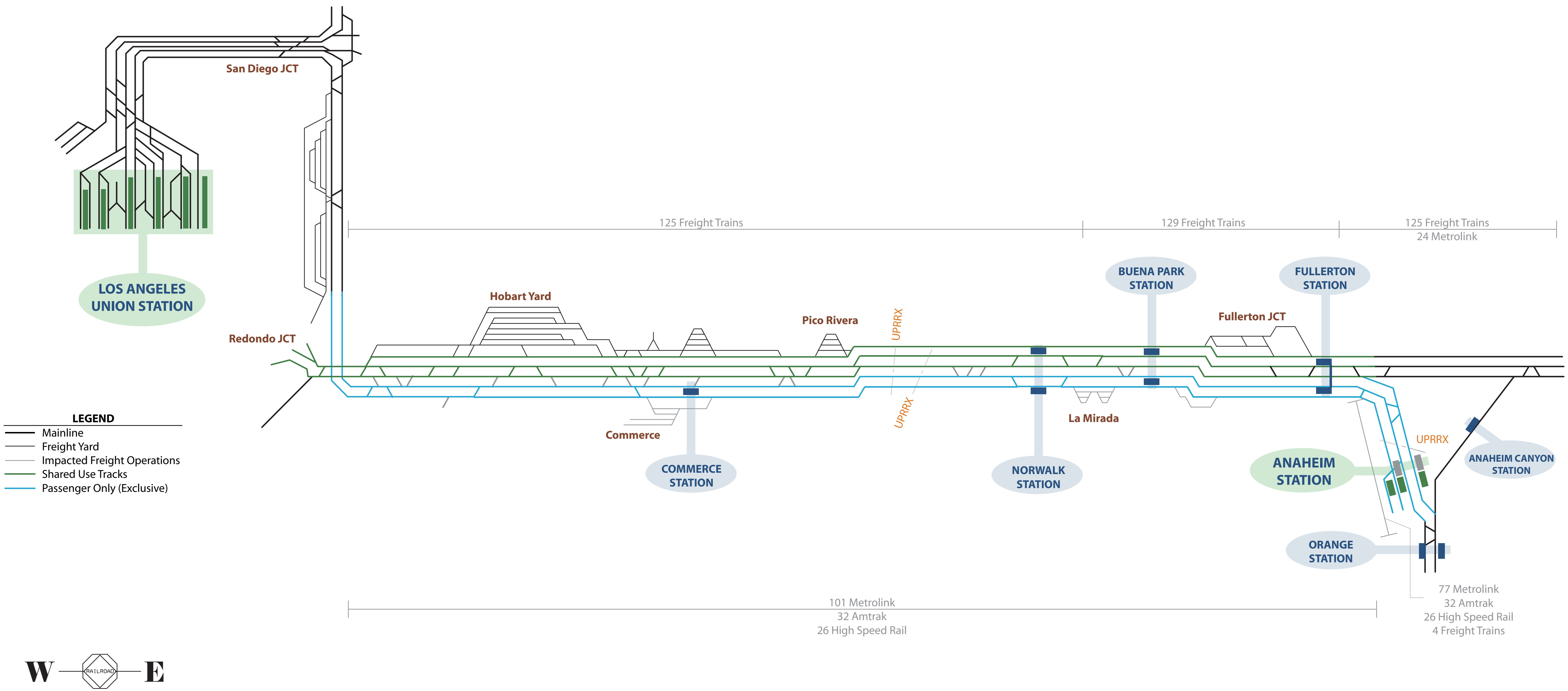


Figure 4 - LOSSAN Corridor Model Case 2 - Three and Two (with Exclusive Use)

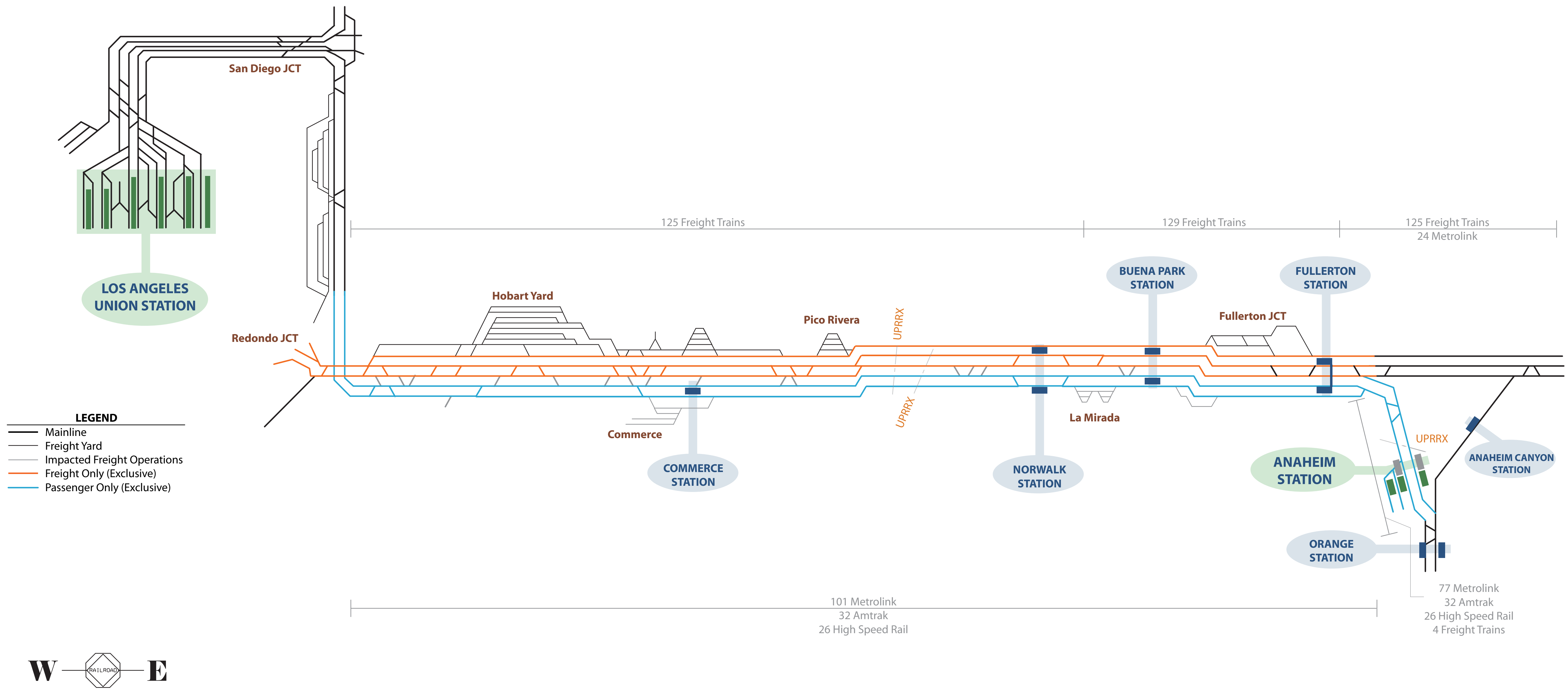


Figure 5 - LOSSAN Corridor Model Case 3 - Three and Two (with Elevated Structure)

Route Concept Schematic Only - Figure to be revised as route configurations are finalized

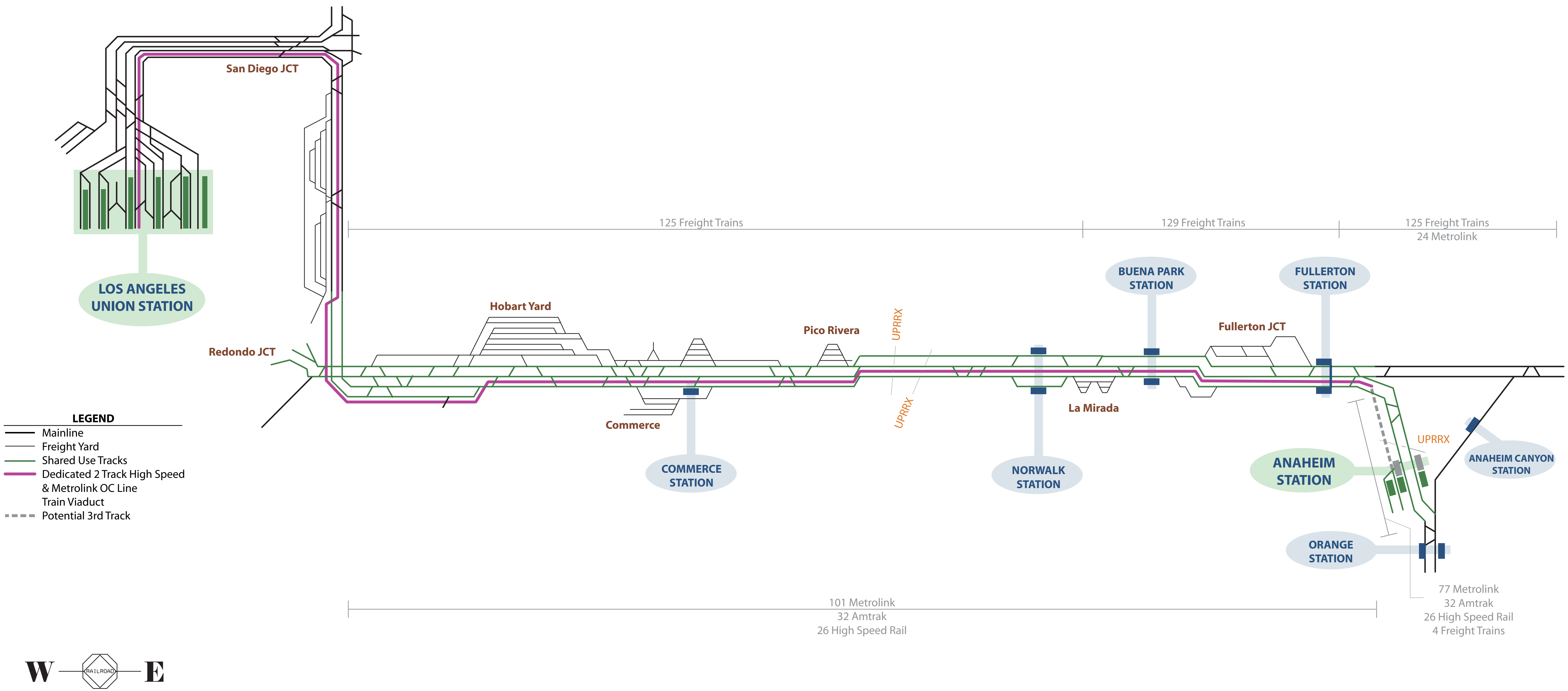


Figure 6 - LOSSAN Corridor Model Case 4 - Four and Two (with Elevated Structure)

Route Concept Schematic Only - Figure to be revised as route configurations are finalized

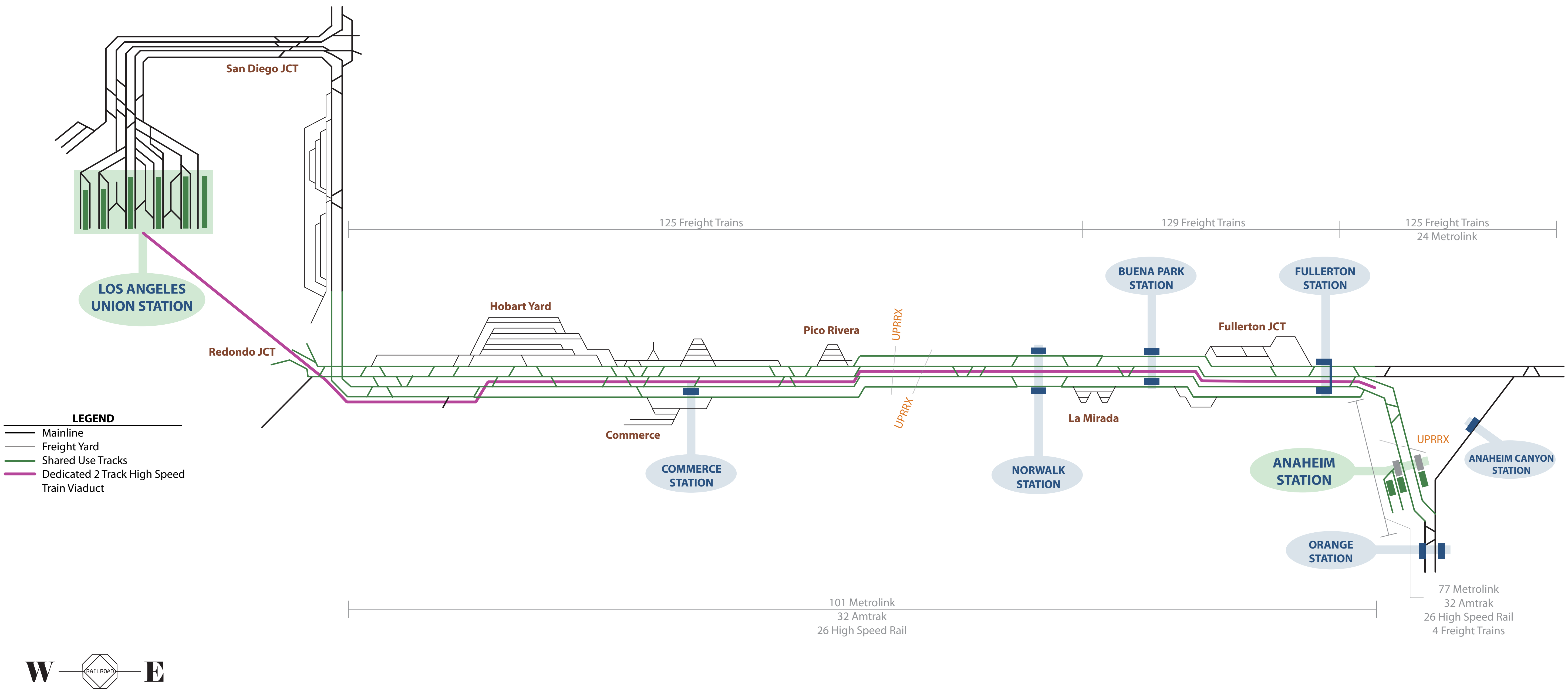


Figure 7 - Model Case 3 Alignment 1

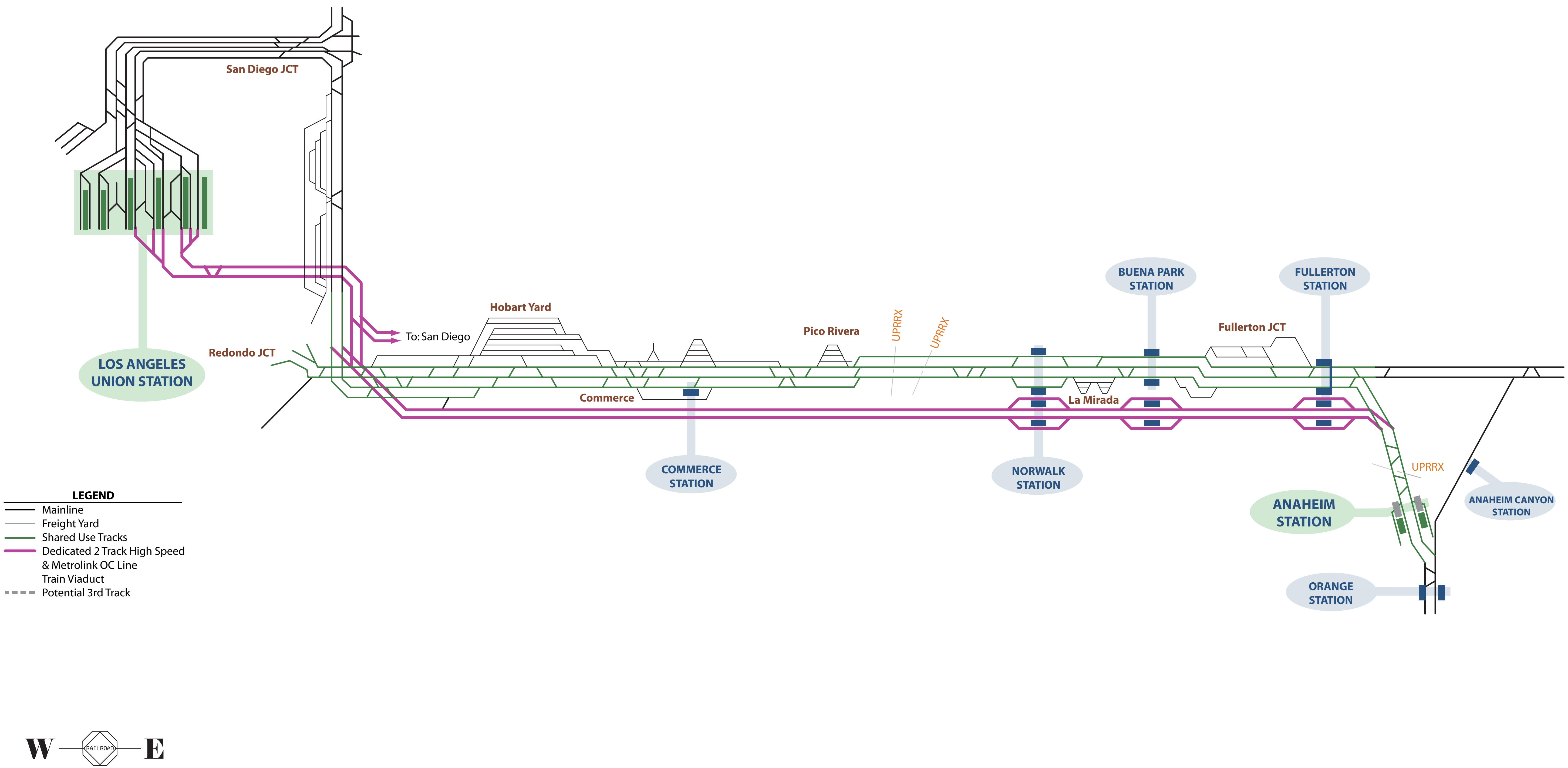


Figure 8 - Model Case 3 Alignment 2

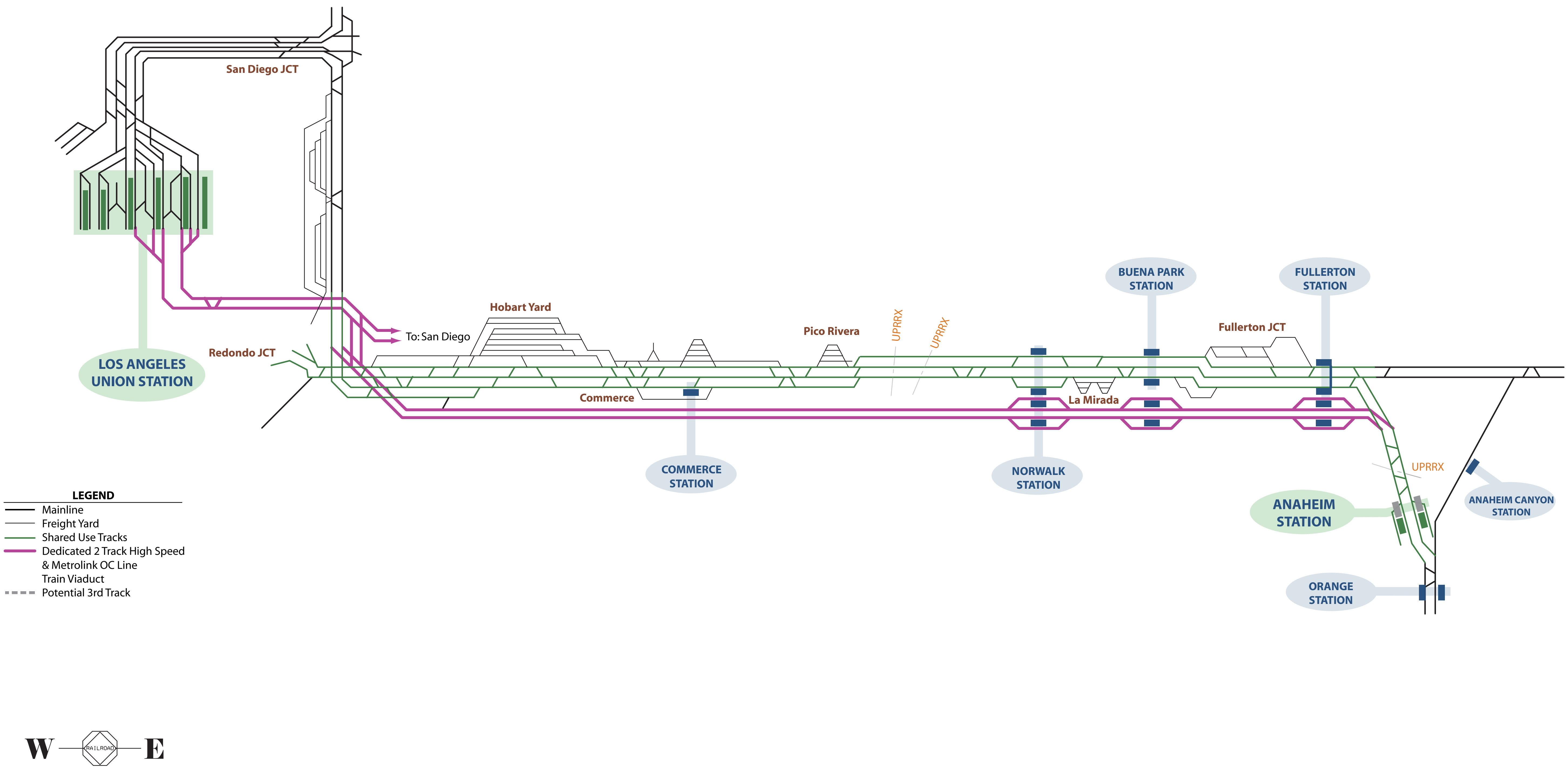


Figure 9 - Model Case 3 Alignment 3

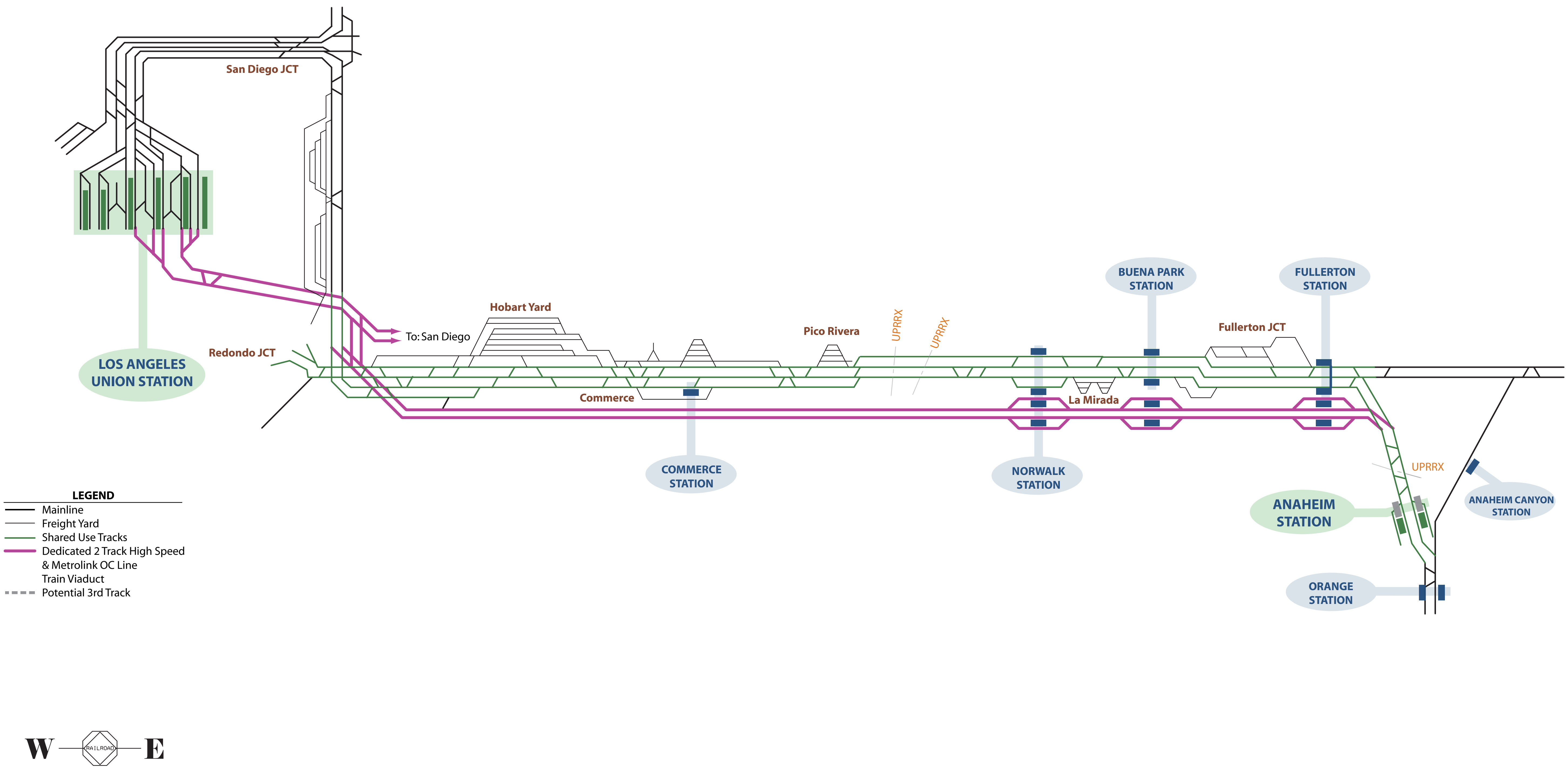
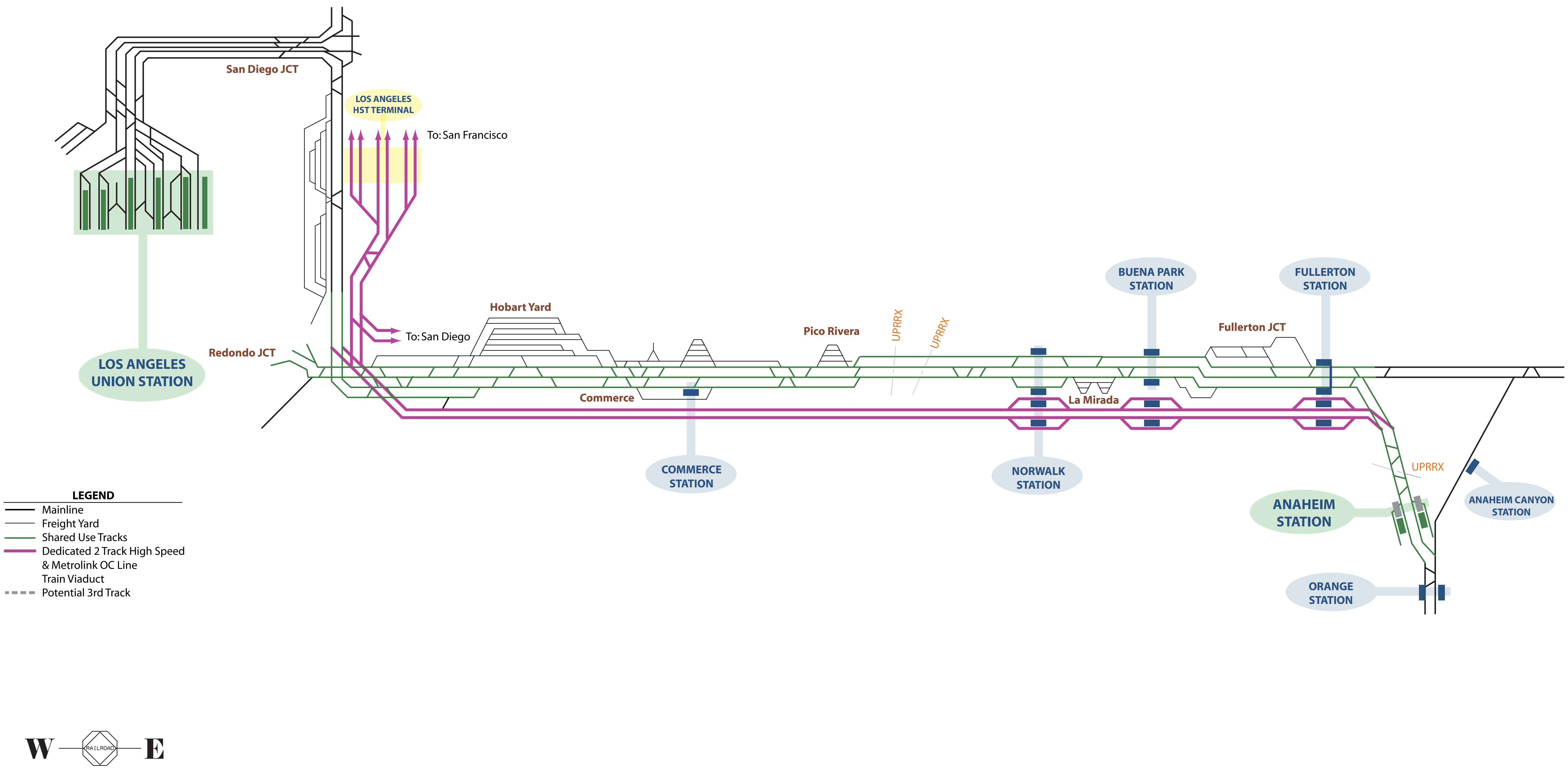


Figure 10 - Model Case 3 Alignment 4



Appendix B
Stringlines

Figure 1 - LOSSAN Corridor Model Case 1 (Freight Only) AM - Two and Two (with Exclusive Use)

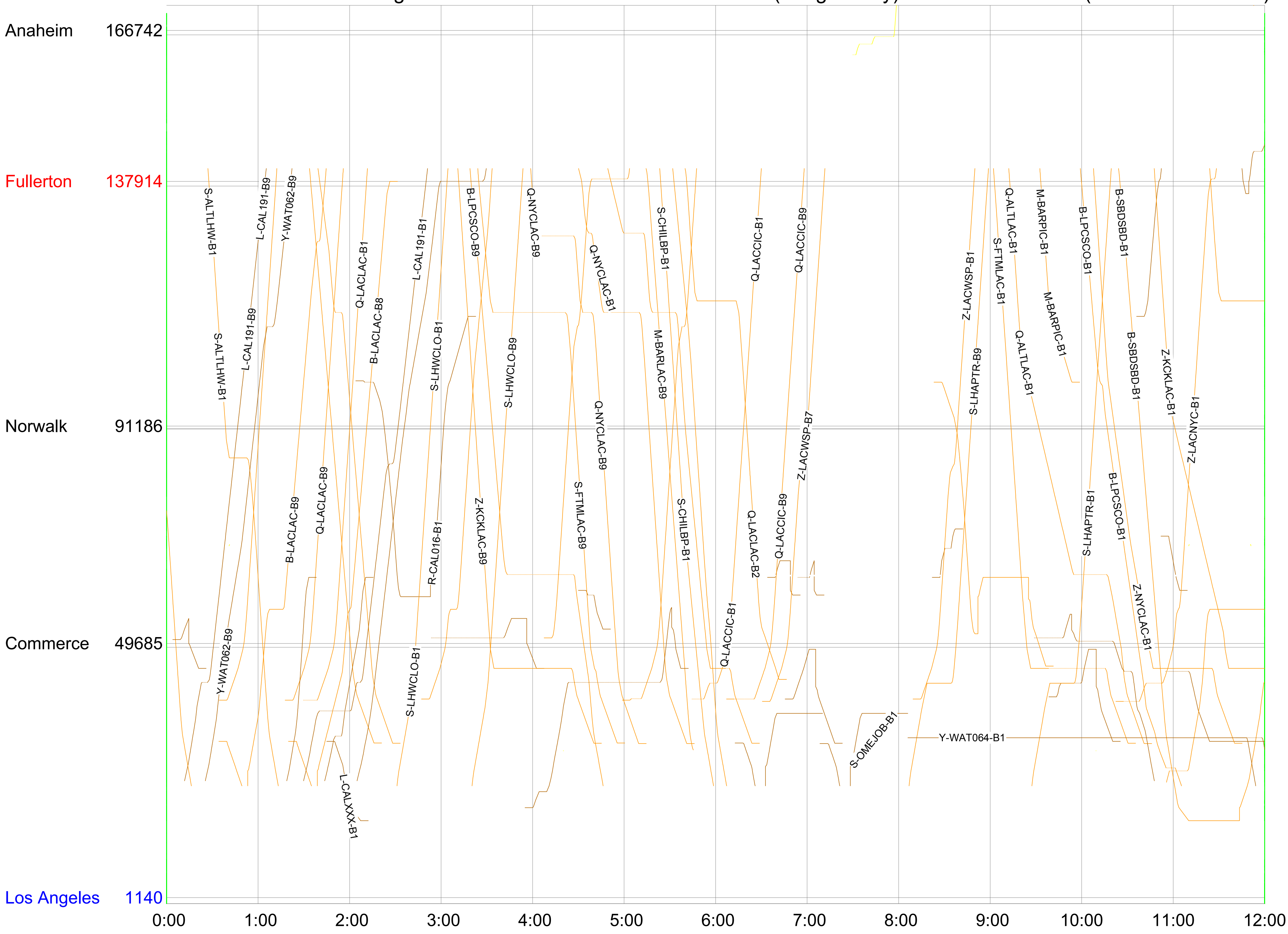


Figure 2 - LOSSAN Corridor Model Case 1 (Freight Only) PM - Two and Two (with Exclusive Use)

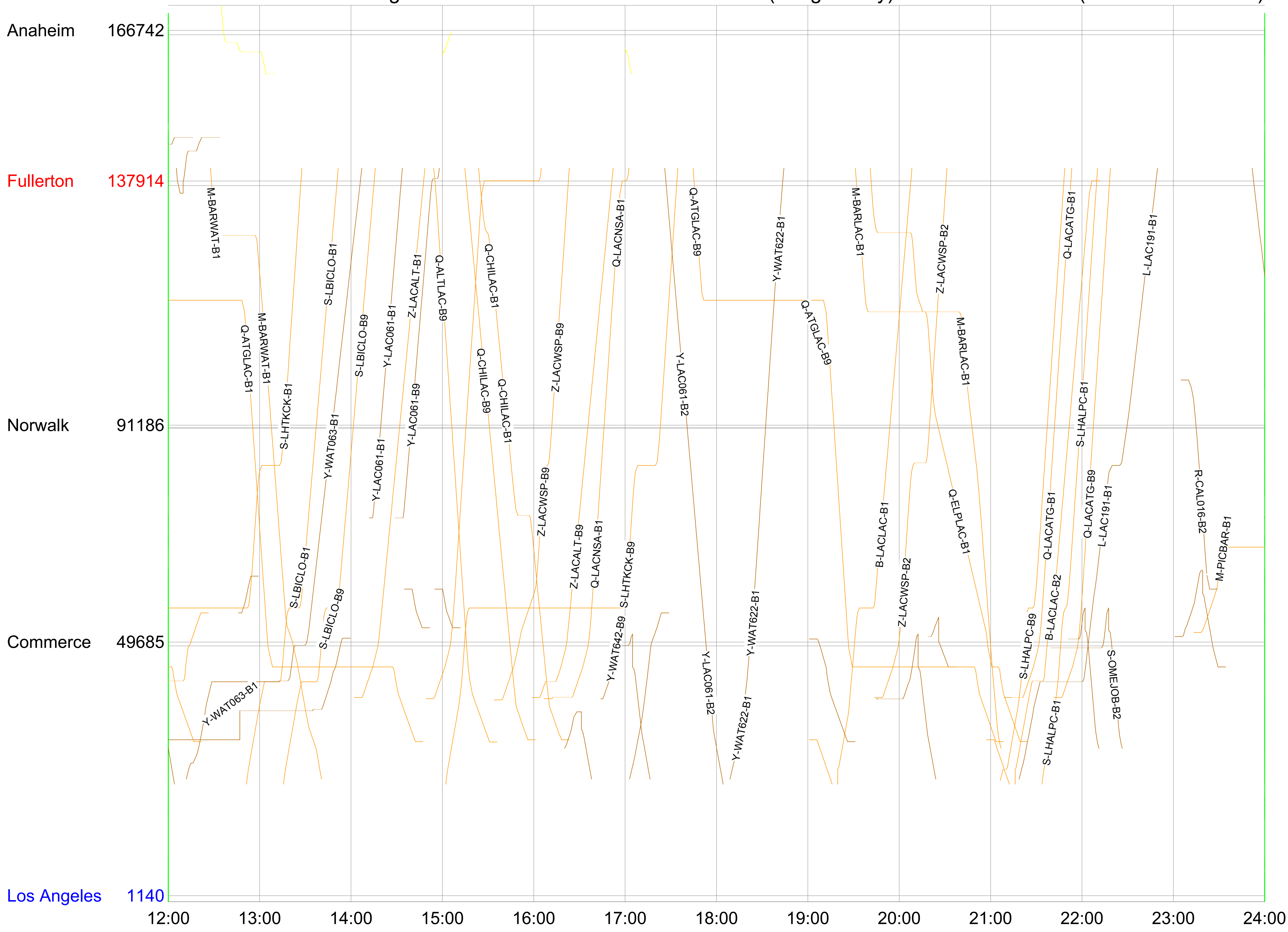


Figure 3 - LOSSAN Corridor Model Case 2 (Freight Only) AM - Three and Two (with Exclusive Use)

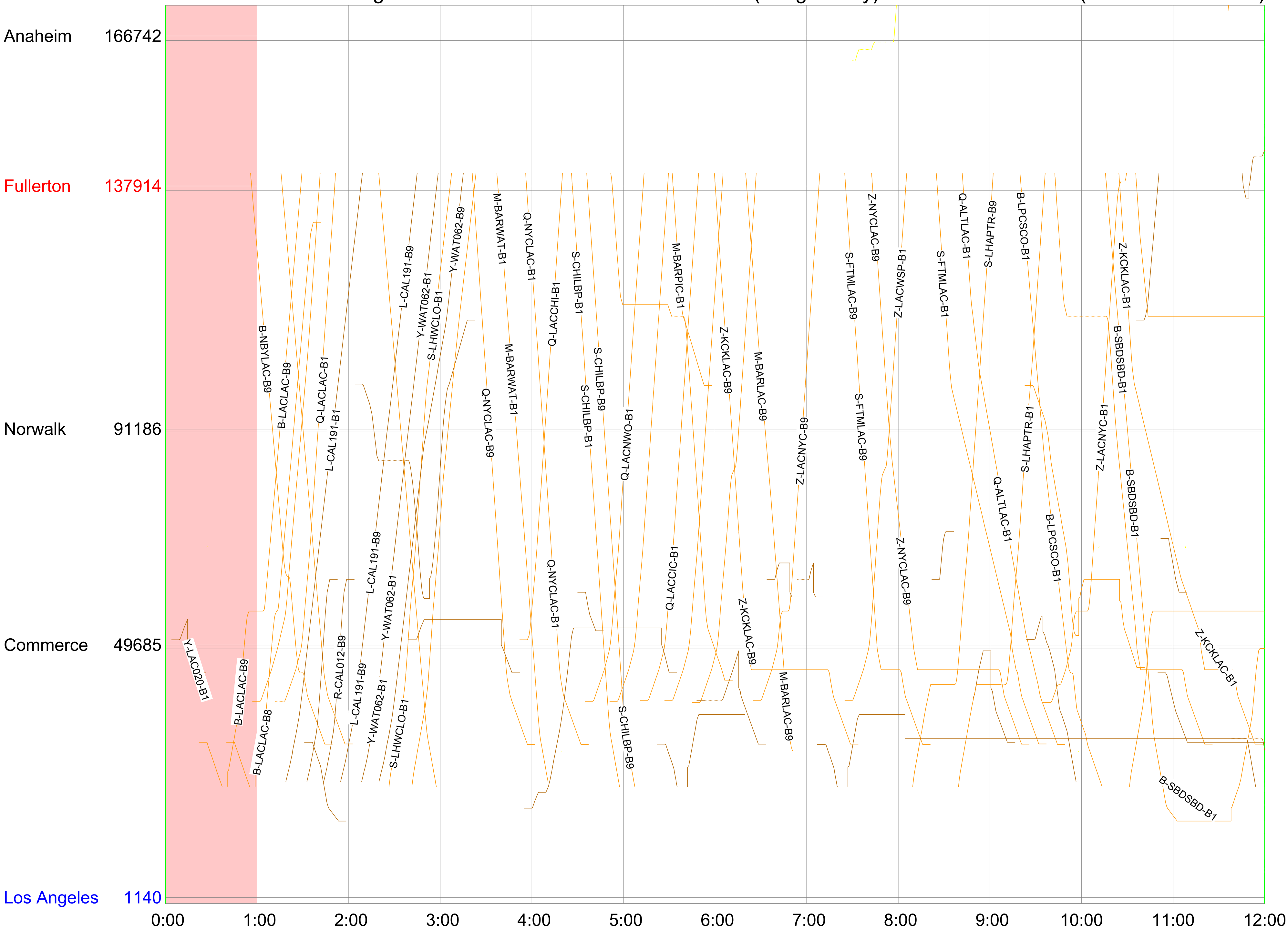


Figure 4 - LOSSAN Corridor Model Case 2 (Freight Only) PM - Three and Two (with Exclusive Use)

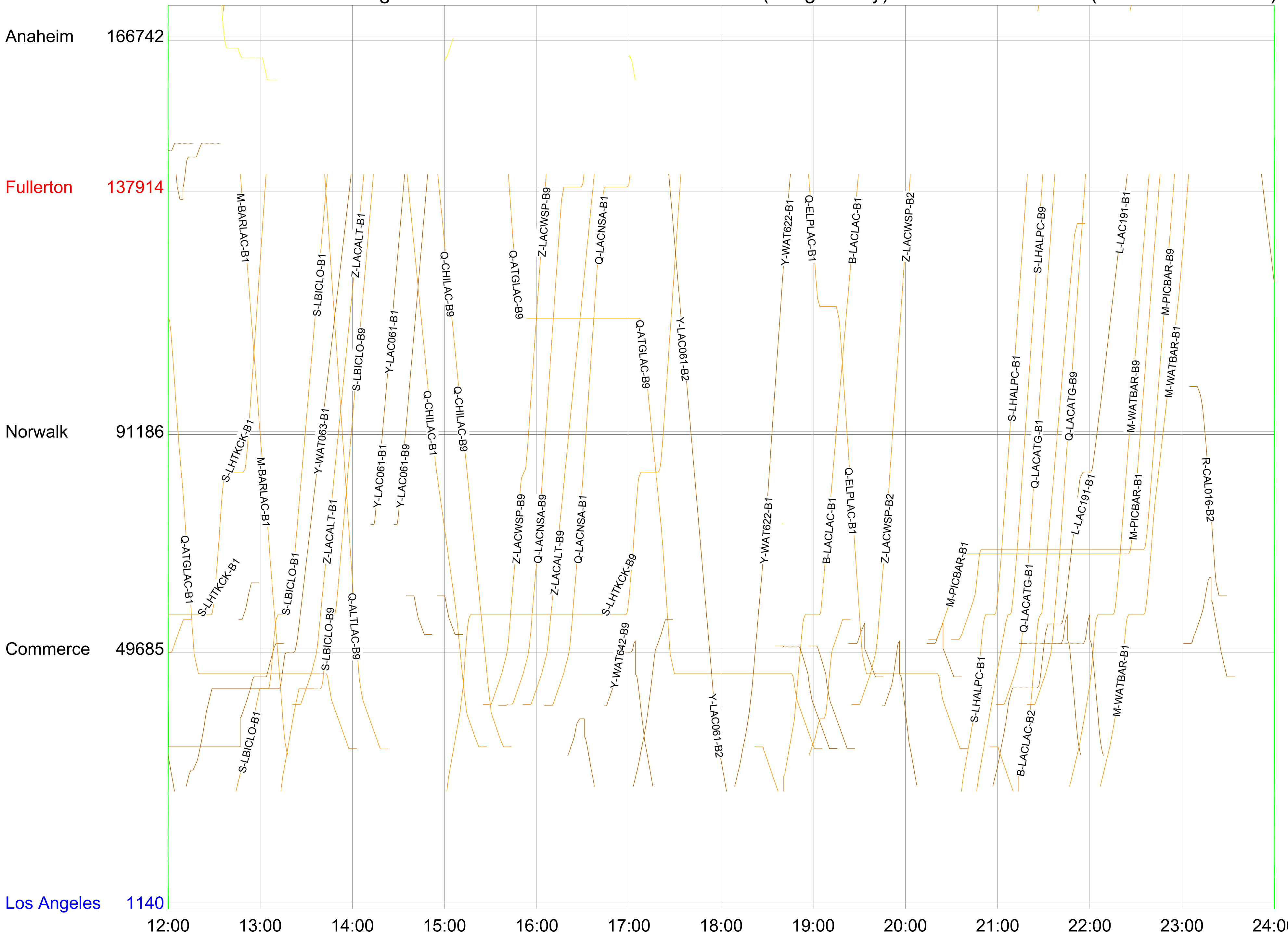


Figure 5 - LOSSAN Corridor Model Case 3 (Freight-Amtrak-91 Line) AM - Three and Two (with Shared Use)

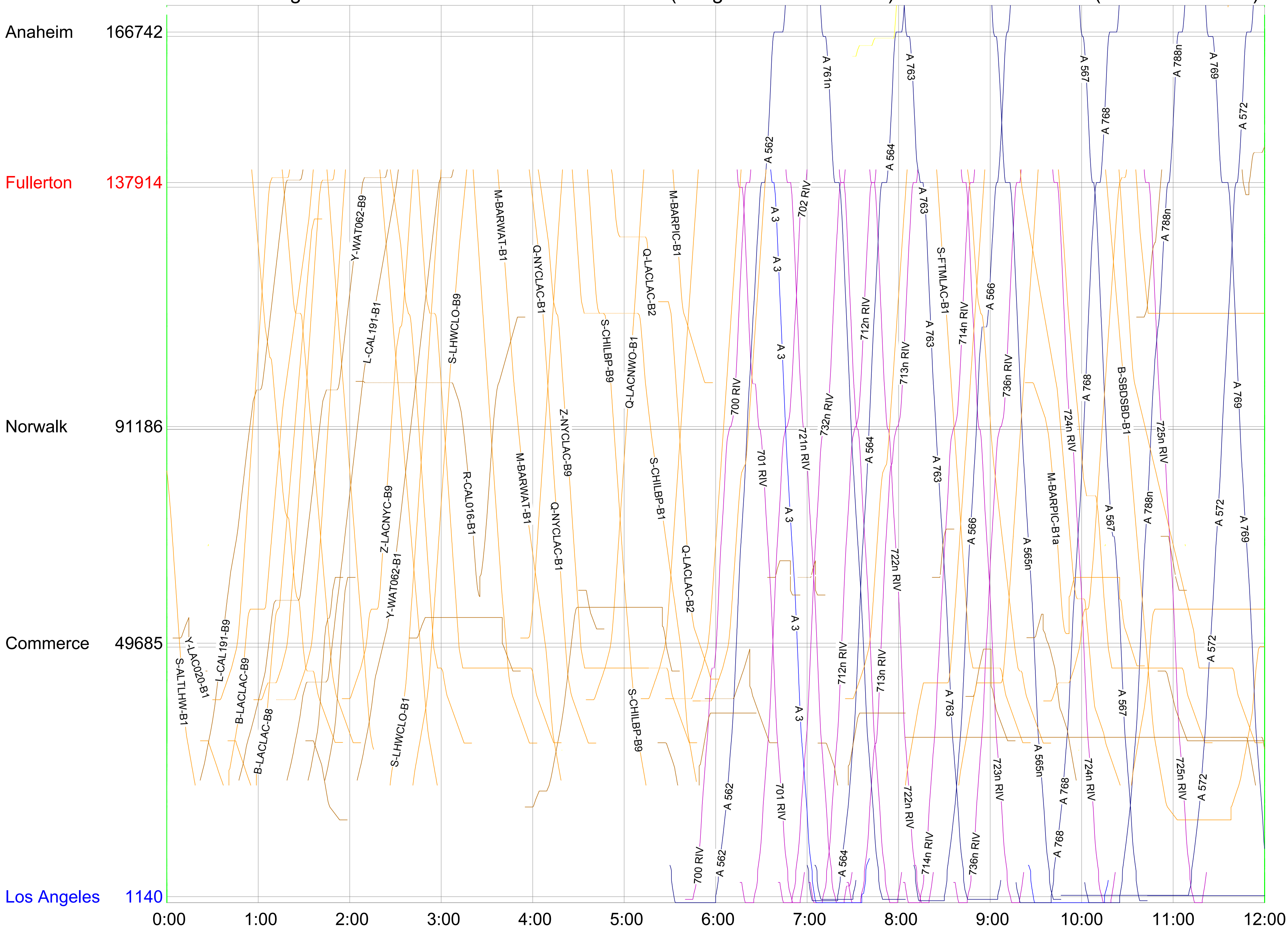


Figure 6 - LOSSAN Corridor Model Case 3 (Freight-Amtrak-91 Line) PM - Three and Two (with Shared Use)

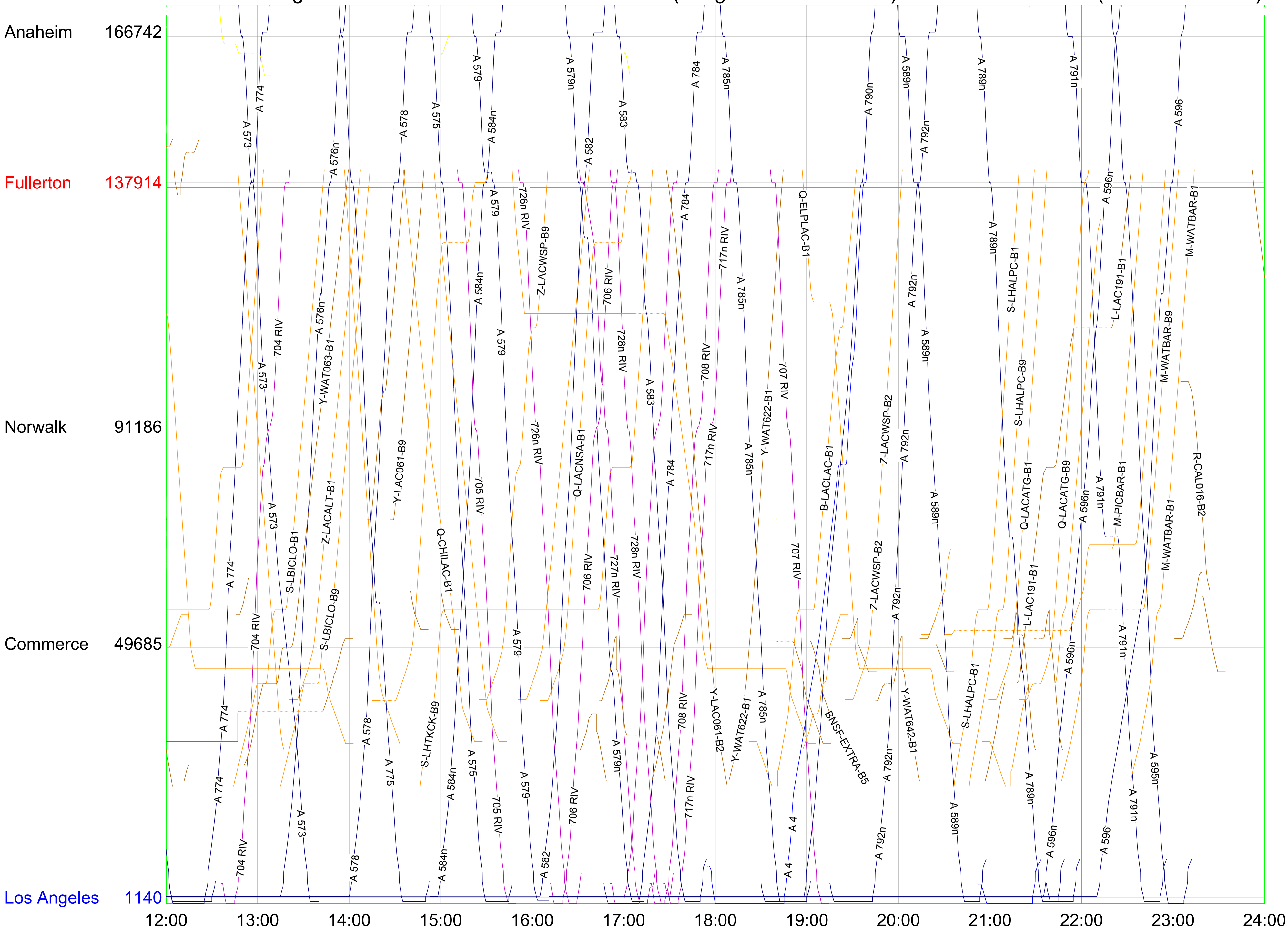


Figure 7 - LOSSAN Corridor Model Case 3 (HSR-OC Line) AM - Three and Two (with Shared Use)

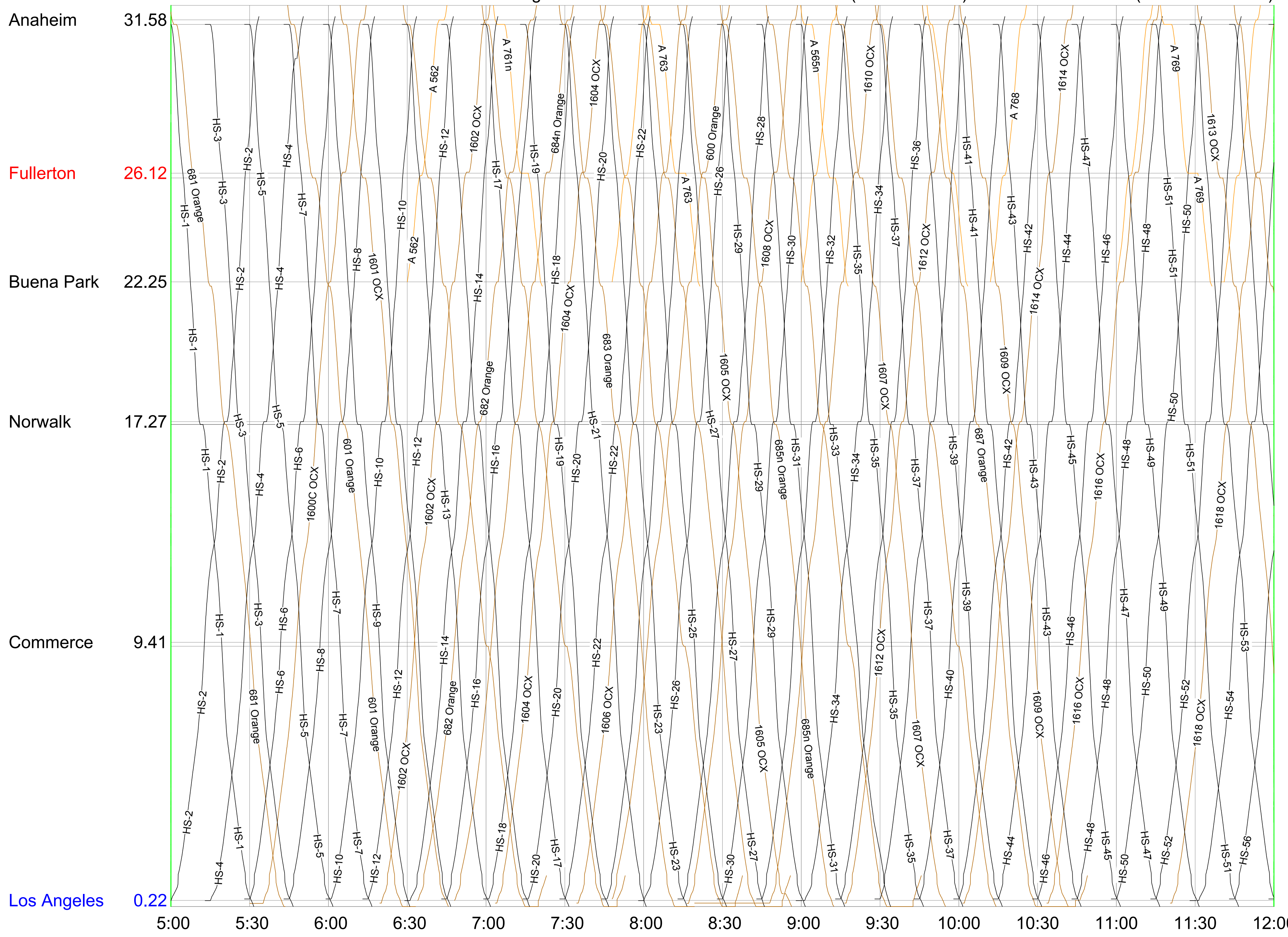


Figure 8 - LOSSAN Corridor Model Case 4 AM - Dedicated High Speed Train with No Stops

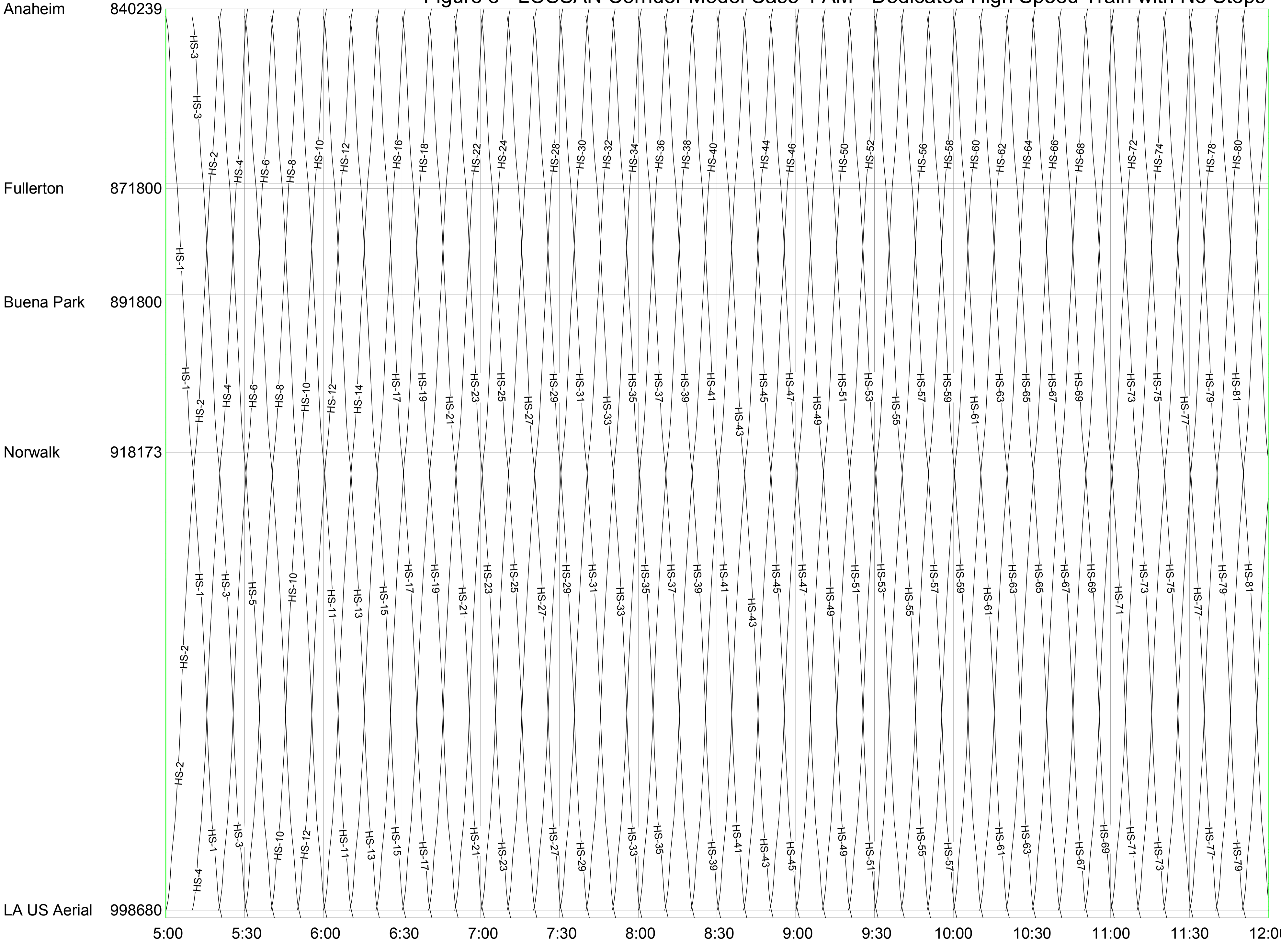


Figure 9 - LOSSAN Corridor Model Case 4 AM - Dedicated High Speed Train with One Stop

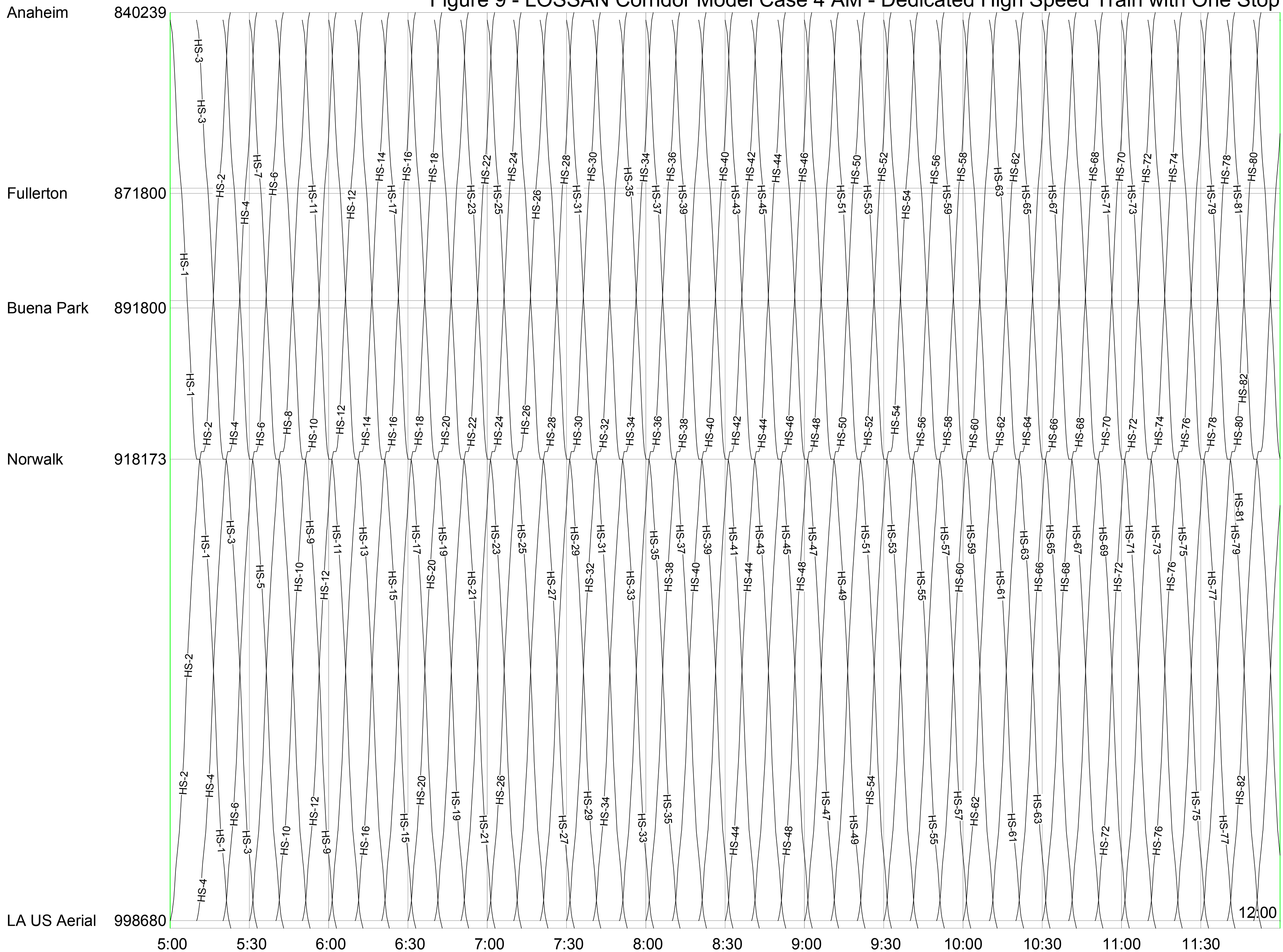


Figure 10 - LOSSAN Corridor Model Case 4 AM - Four and Two (with Shared Use)

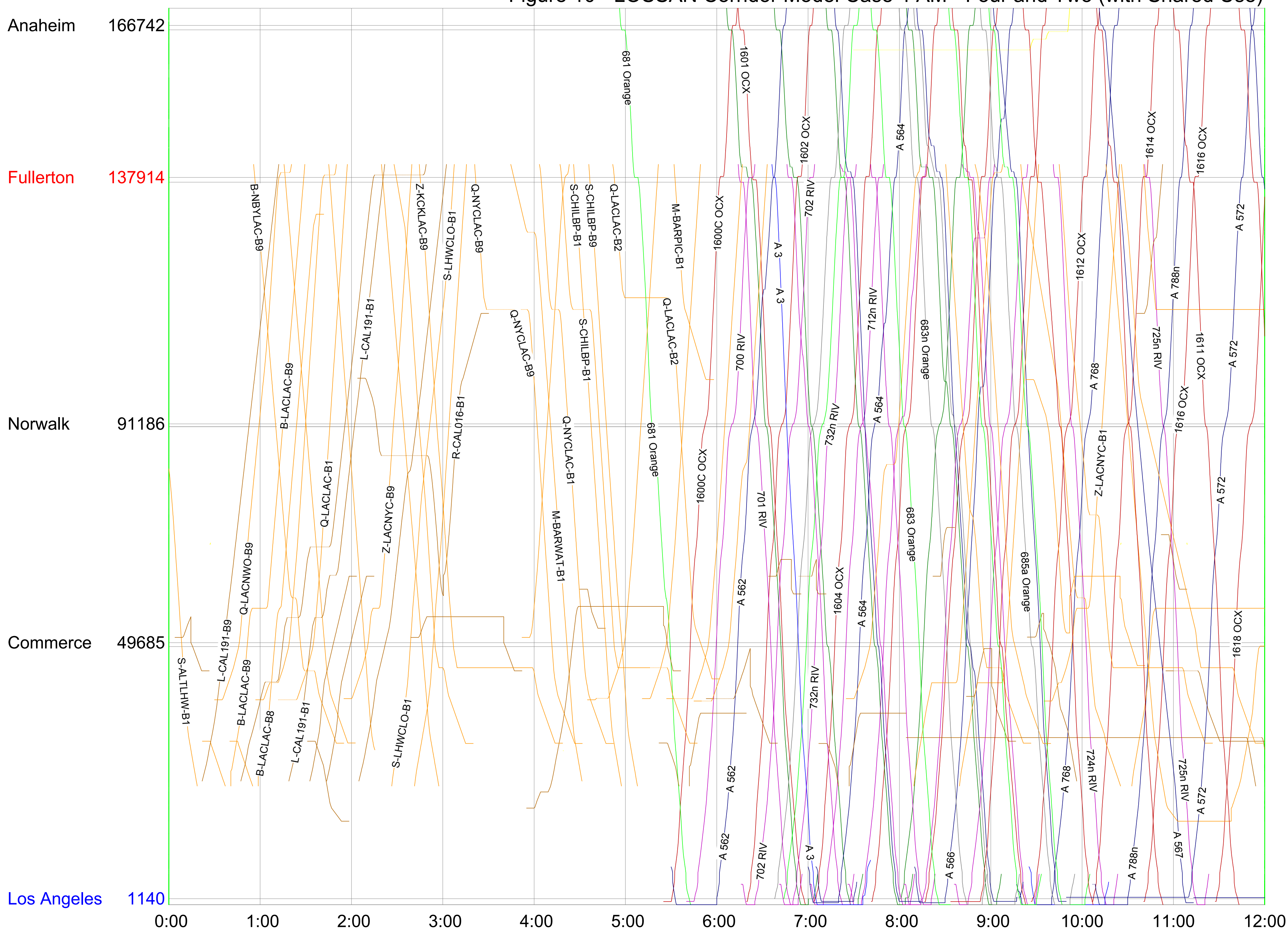


Figure 11 - LOSSAN Corridor Model Case 4 PM - Dedicated High Speed Train with No Stops

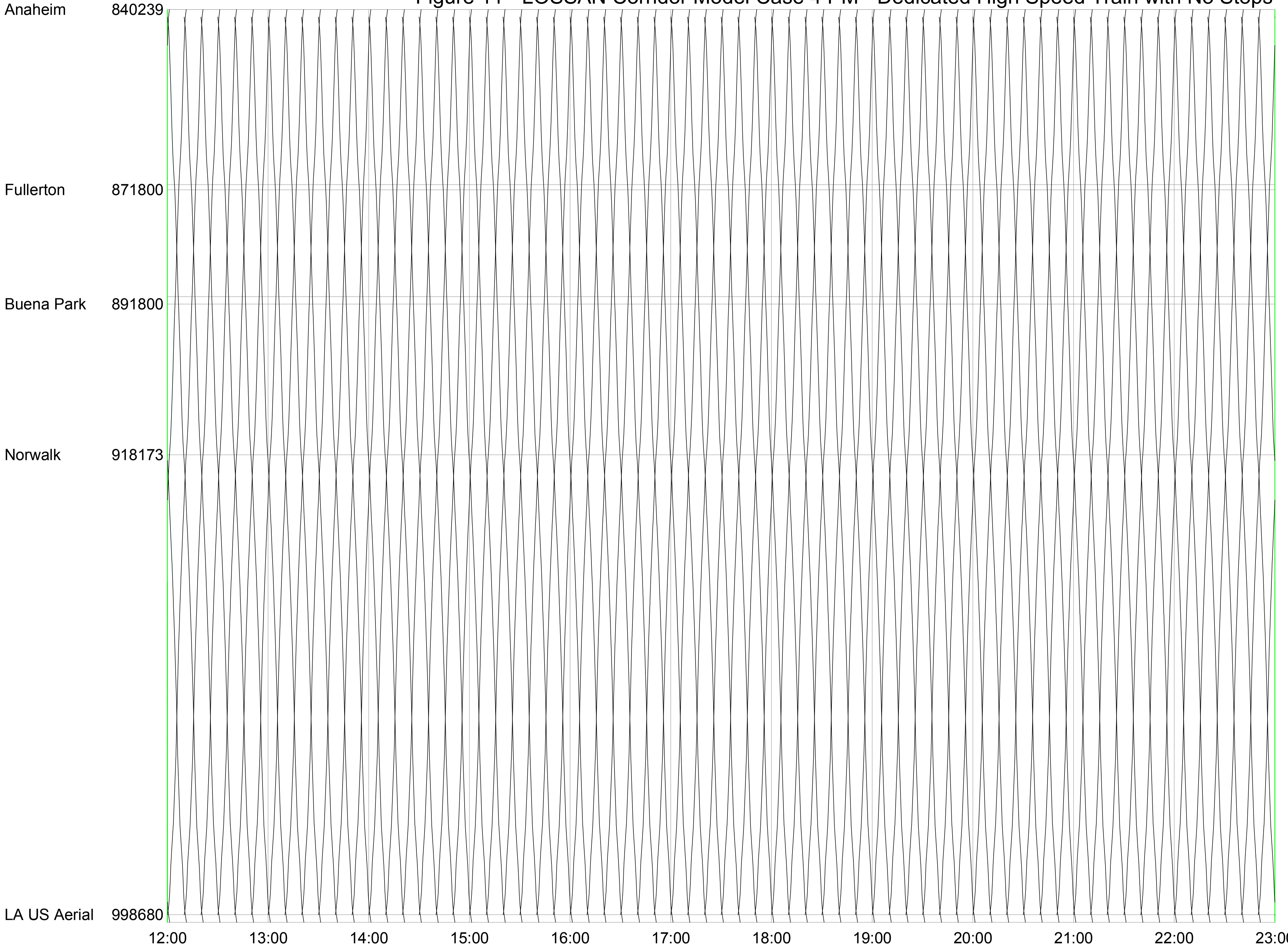


Figure 12 - LOSSAN Corridor Model Case 4 PM - Dedicated High Speed Train with One Stop

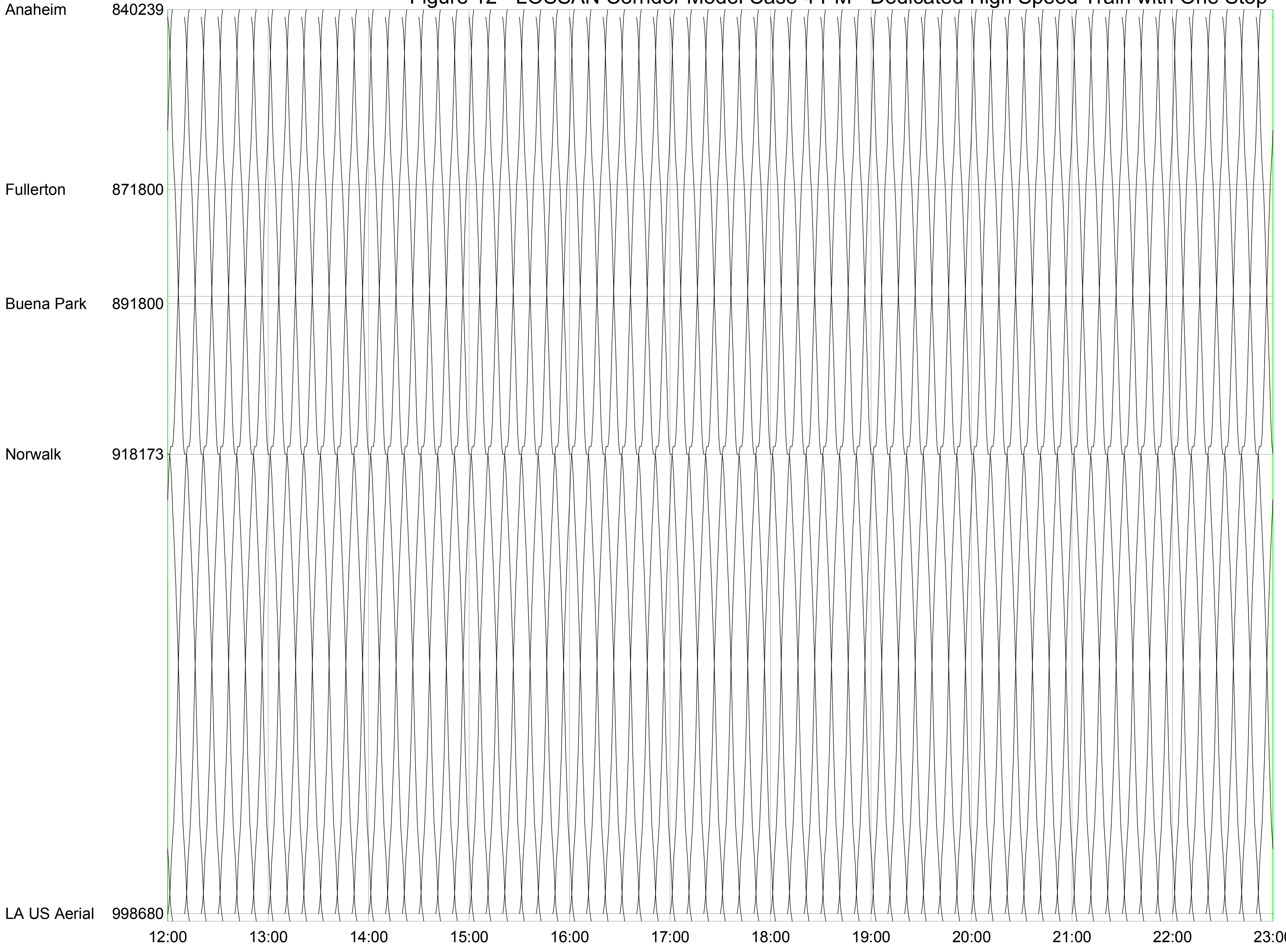


Figure 13 - LOSSAN Corridor Model Case 4 PM - Four and Two (with Shared Use)

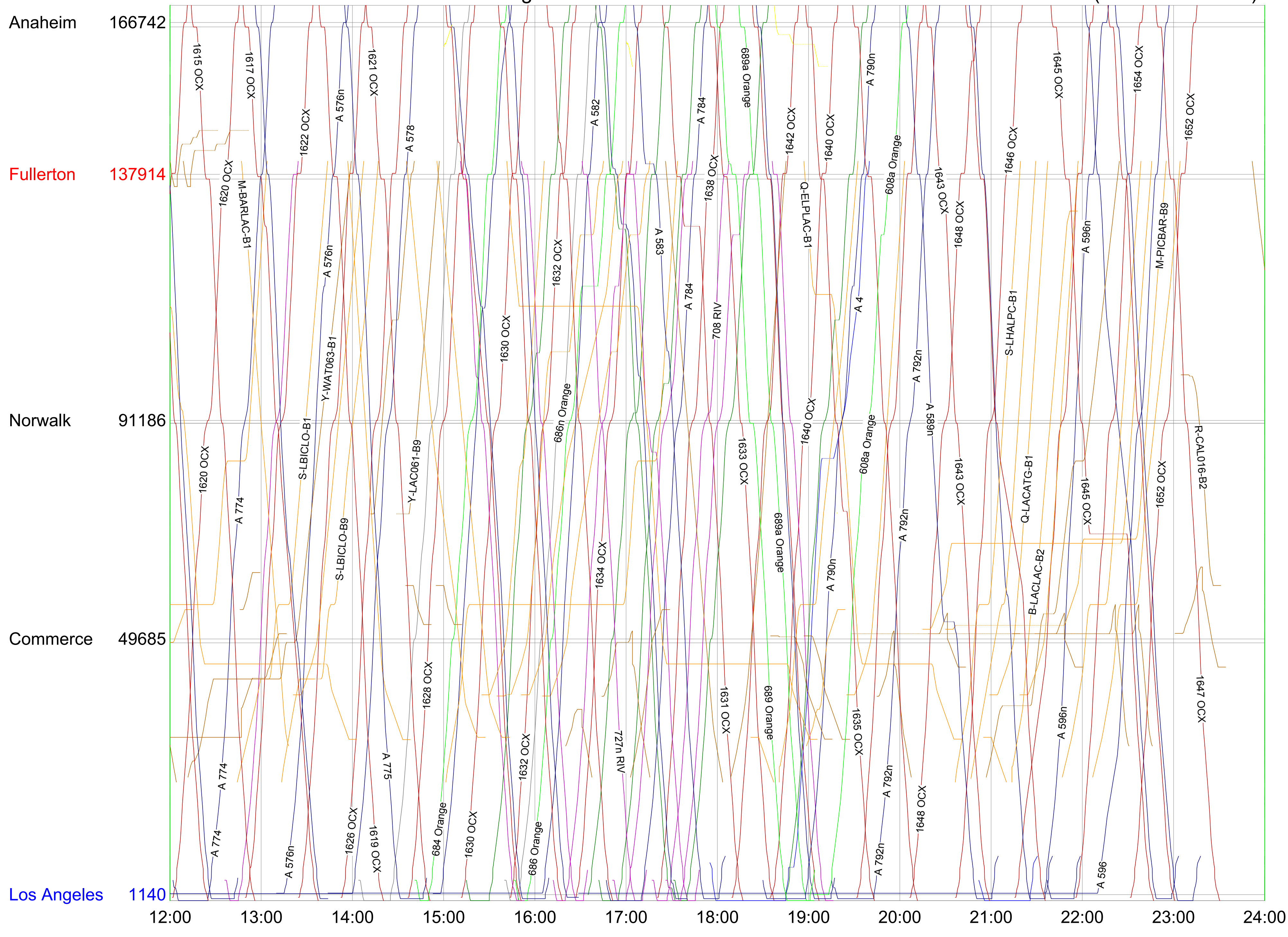


Figure 14 - LOSSAN Corridor Model Cases 1 & 2 (4AM-10AM) - 2 Dedicated Passenger Tracks

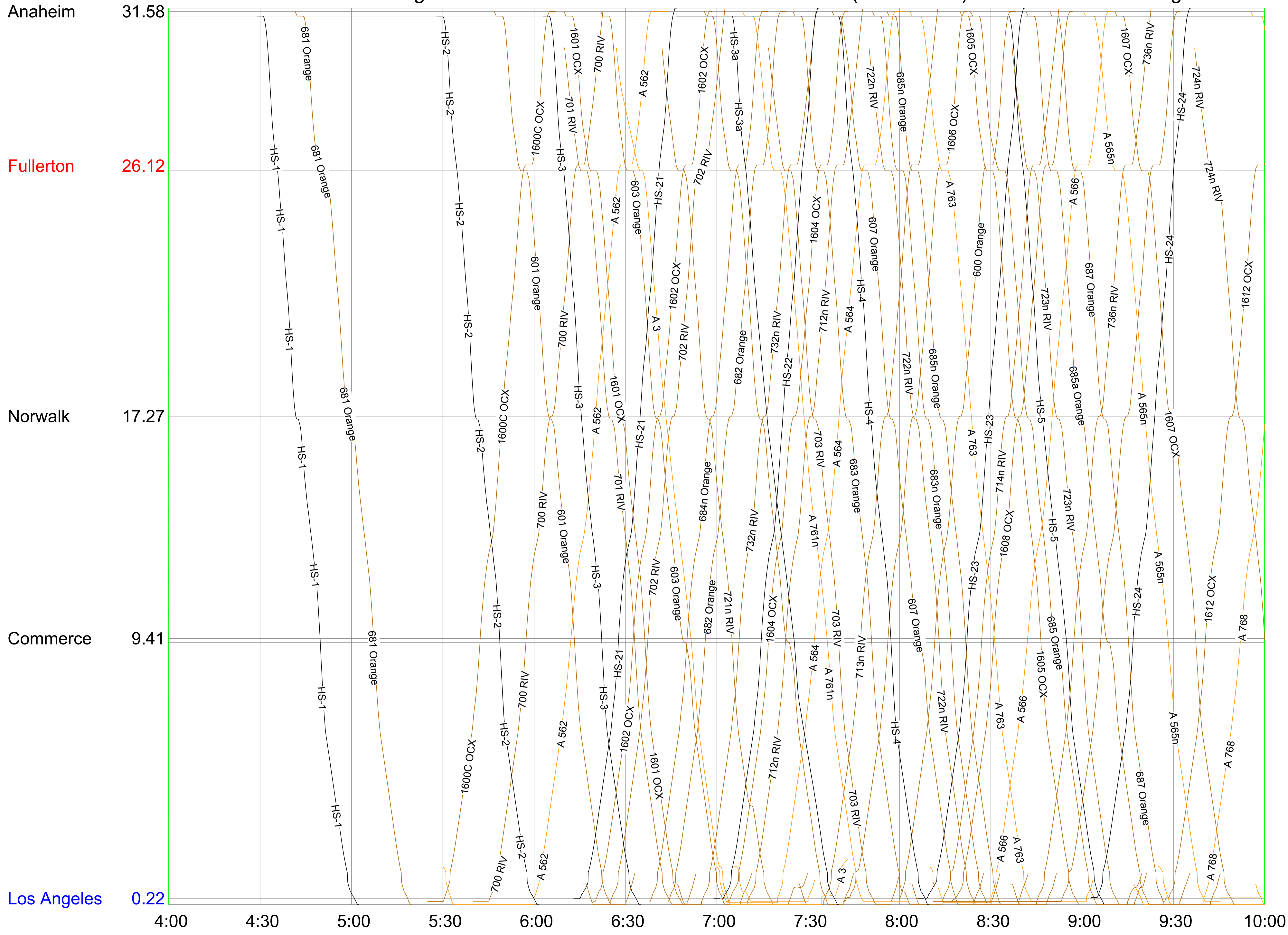


Figure 15 - LOSSAN Corridor Model Cases 1 & 2 (5PM-11PM) - 2 Dedicated Passenger Tracks

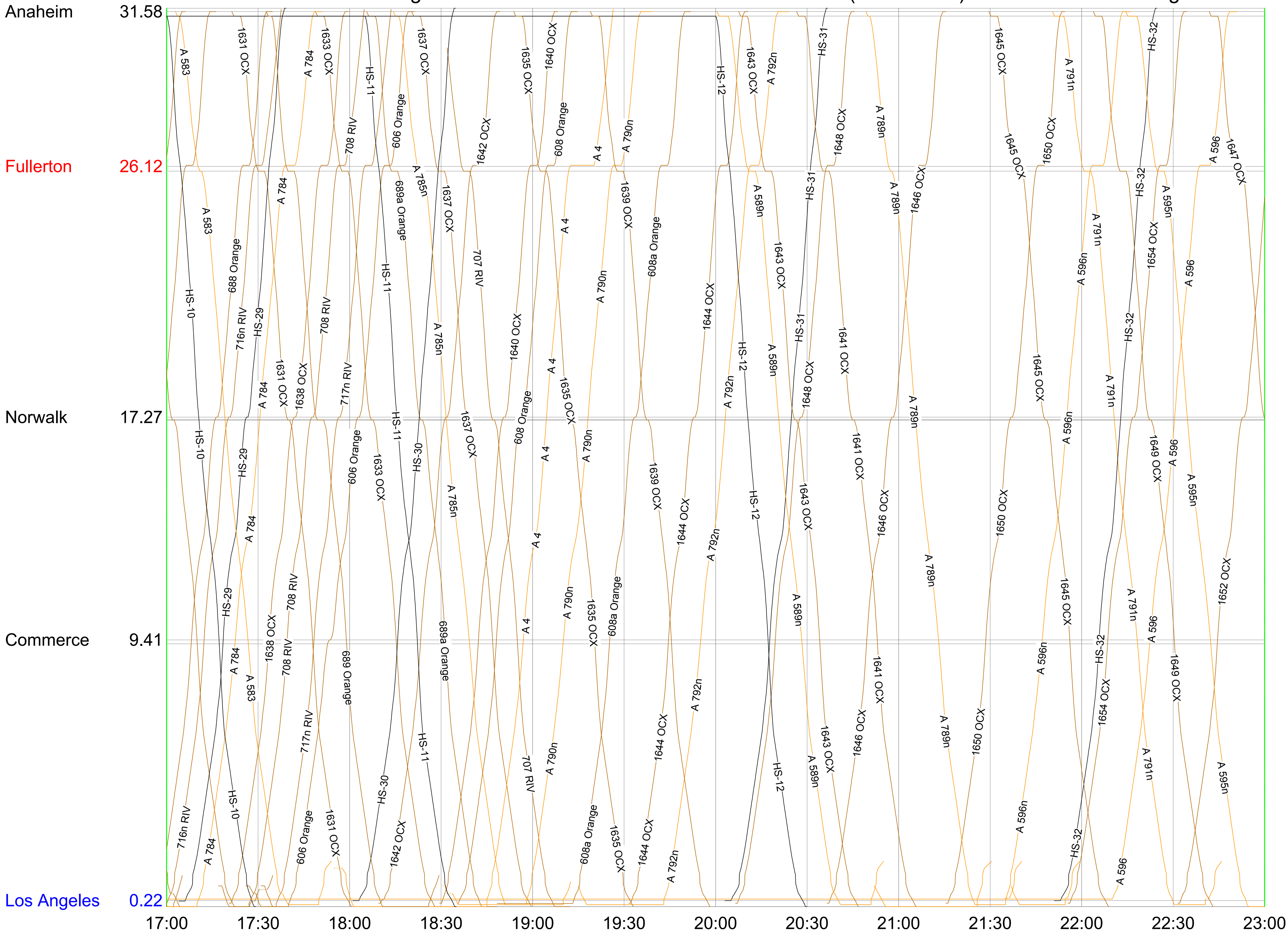


Figure 16 - LOSSAN Corridor Model Cases 1 & 2 (10AM-5PM) - 2 Dedicated Passenger Tracks

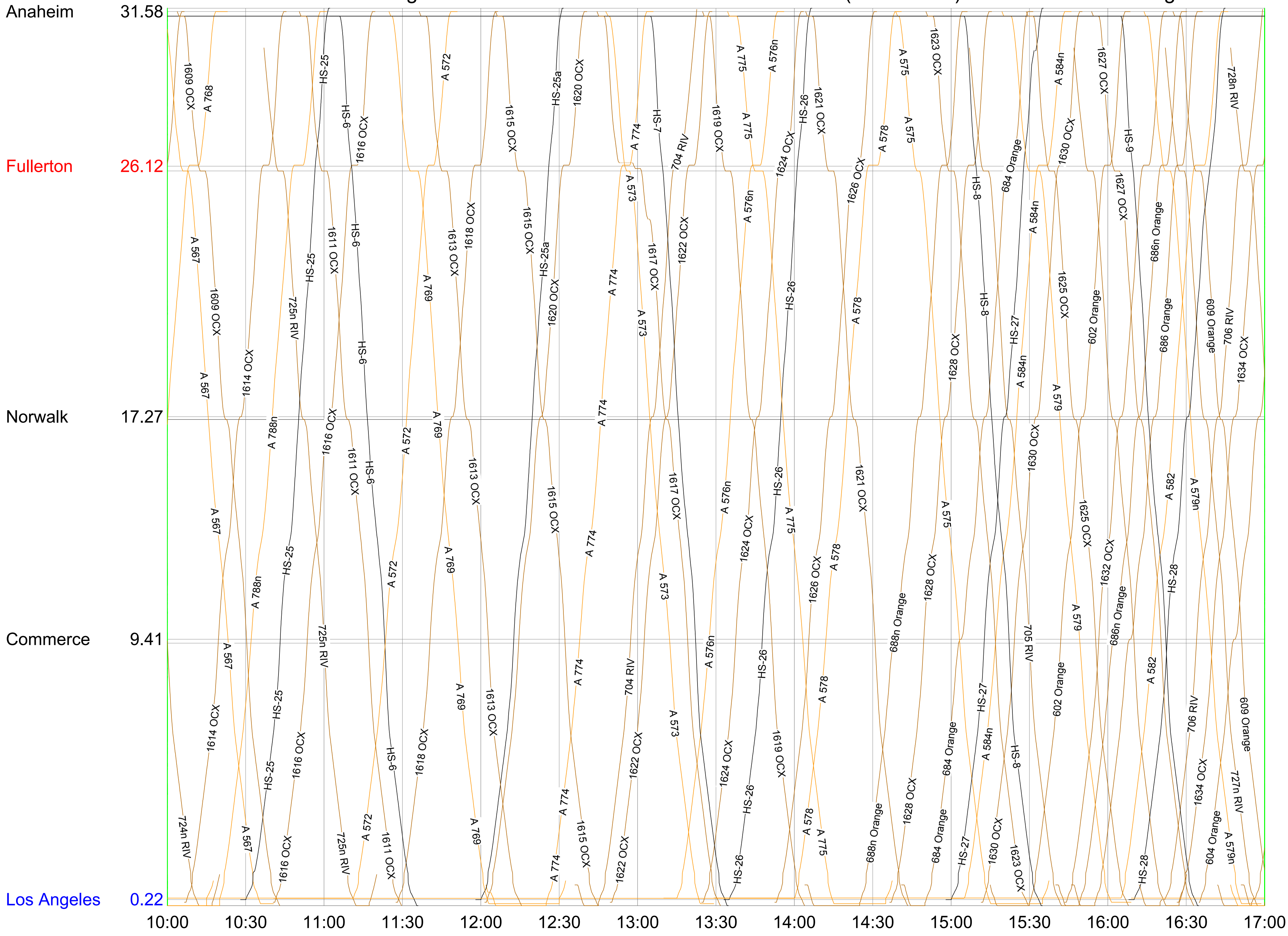
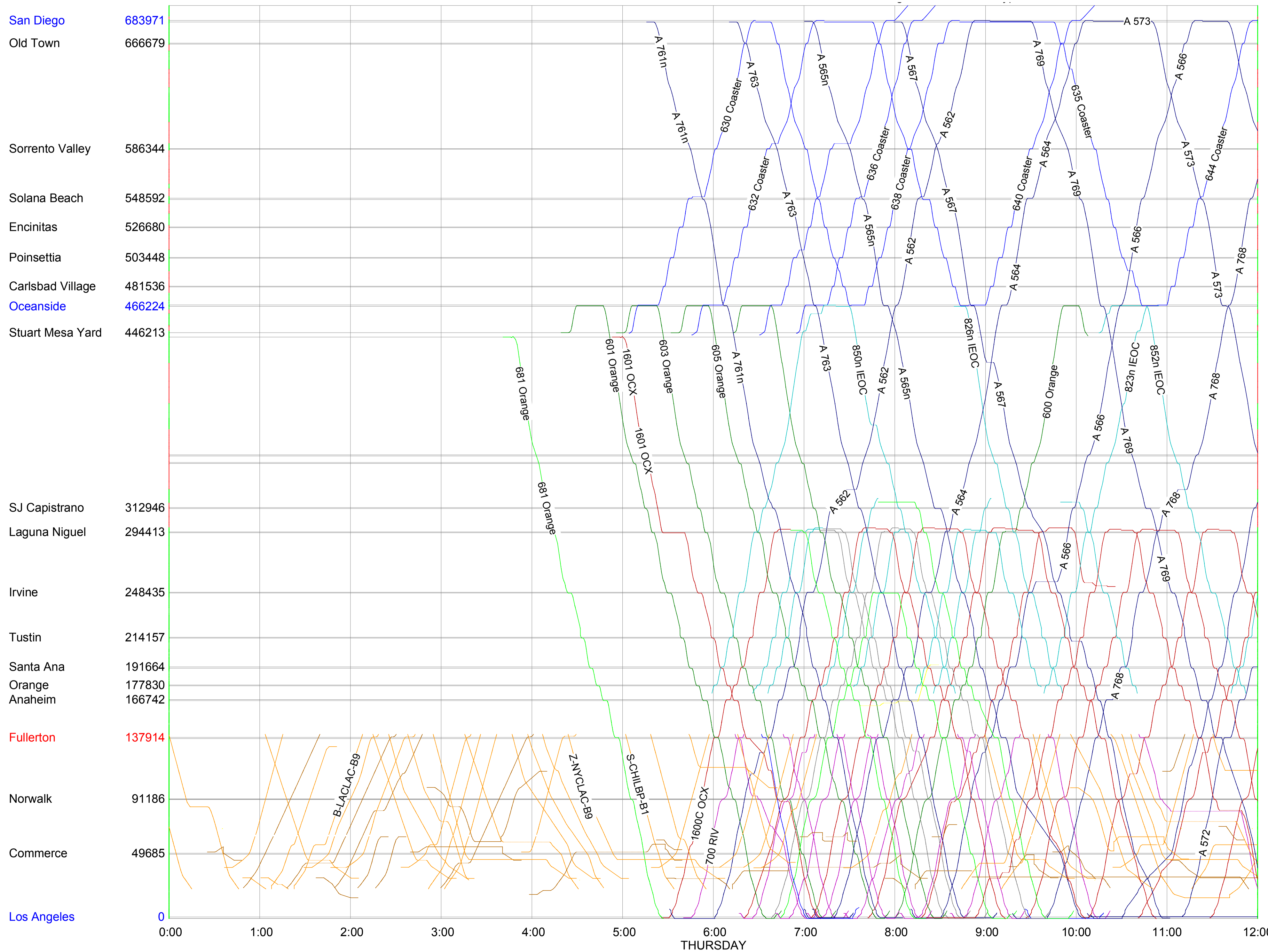
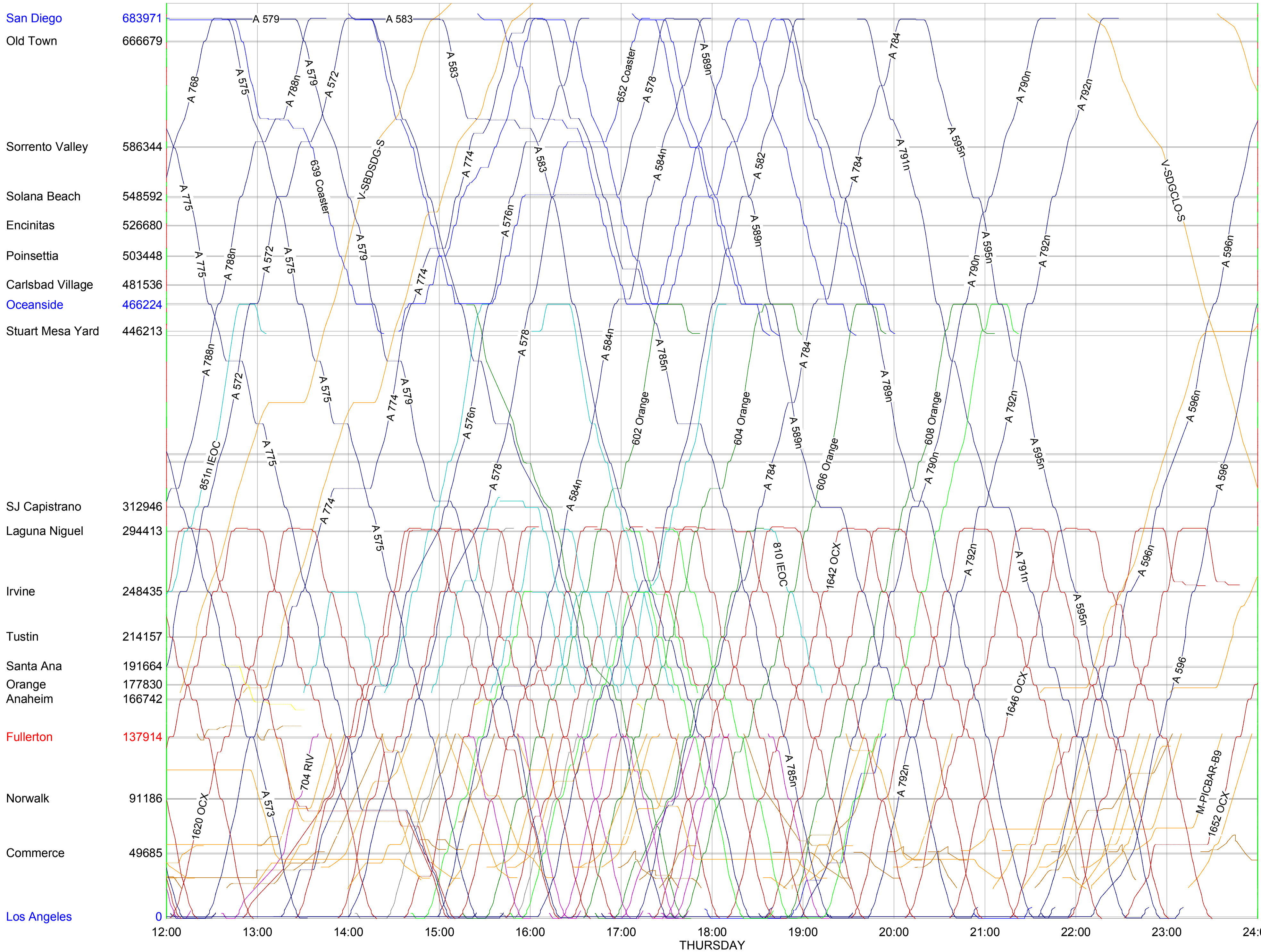


Figure 17 - LOSSAN Corridor Model Case 5 AM - Four Track No-Build



All times displayed in Pacific time RTC version: 2.70 R46V Run time: 20 May 2008 14:16:16

Figure 18 - LOSSAN Corridor Model Case 5 PM - Four Track No-Build



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